THE PHONOLOGICAL DEVELOPMENT OF MALAYSIAN ENGLISH SPEAKING CHINESE CHILDREN: A NORMATIVE STUDY

Phoon Hooi San

Bachelor of Speech Sciences (Hons)

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

University of Canterbury

Te Whare Wānaga o Waitaha

Christchurch, New Zealand

May, 2010

The material presented in this thesis is the original work of the candidate except as acknowledged in the text, and has not been previously submitted, either in part or in whole, for a degree at this or any other University.

Phoon Hooi San

ACKNOWLEDGMENT

I would not have been able to complete my PhD journey without the aid and support of countless people over the past three years. Foremost, I would like to express my deepest sense of gratitude to my supervisor, Associate Professor Dr. Margaret Maclagan for her patient guidance, encouragement and excellent advice throughout this study. I could not have imagined having a better supervisor and mentor for my PhD study. I also would like to express my sincere gratitude to my co-supervisor, Professor Dr. Michael Robb, for his immense knowledge, support and guidance.

I would like to express my gratitude to the University of Canterbury International Doctoral Scholarship for financing my study. I acknowledge my gratitude to Dr. Chew Theam Yong, Dr. Emily Lin and Angie Yeoh for their valuable assistances in my data programming, statistical analyses and artwork respectively. I am thankful to several research assistants for their generous assistance in preparing the data for analysis. I would like to thank the anonymous reviewers for their comments and suggestions for the published papers resulting from my thesis.

This research project would not have been possible without the participants' involvement. I wish to express my gratitude to Malaysian speech-language pathologists, Malaysian students at the University of Canterbury, preschool and school children in Penang as well as their parents for their willingness to participate in my research. My sincere thanks also go to principals and teachers, for allowing me to recruit children from their nurseries, kindergartens or schools.

I would like to convey special thanks to all my PhD friends for their peer support and invaluable assistance. I wish to thank Wong Tze Peng in particular; her peer support, academic insights and comments were invaluable over the years. I also thank my ex-colleague and inspiring friend, Low Hui Min for sharing her PhD experiences and knowledge during the time of my study. I am not forgetting my best friends in Malaysia and friends in New Zealand who always been there for me.

I would like to thank my family: my parents, in-laws, siblings and aunty for supporting me spiritually throughout my life. Last but not the least, I wish to express my love and gratitude to my beloved husband, Teoh Cheau Yang for his understanding and endless love, through the duration of my study.

ABSTRACT

The lack of culturally appropriate norms for assessing the speech and language status of Malaysian children has been an ongoing issue in Malaysia. At present, there are no normative data against which to assess the phonological skills of Malaysian children. Malaysian Chinese children are usually bilingual or multilingual. They acquire English, Mandarin Chinese and Malay during their preschool years. English that is used in Malaysia is commonly recognized as Malaysian English (MalE). MalE has distinctive phonological characteristics that are different from those of so-called Standard English (SE). However, the variations of MalE may not be completely understood by many speech-language pathologists (SLPs) in Malaysia, and this may lead to difficulty in differentiating speech differences resulting from MalE dialectal features and true speech disorders. As well as establishing speech norms for MalE speaking children, information is needed about the current assessment practices of the phonological development of MalE speaking children. Three studies were carried out for the present thesis.

The first study was designed to provide insight into Malaysian SLPs' perspectives on the current use of articulation and phonology assessments in the country. It reports the results of a survey of 38 Malaysian SLPs in term of the types of articulation and phonological assessments currently used, SLPs' perceptions about the adequacy and accuracy of current articulation and phonological assessment in meeting clinical needs, the experiences of SLPs in using current articulation and phonological assessments, as well as their perception of the need for further research in the areas of articulation and phonology. The findings indicated that informal articulation or phonological assessments were widely used. Only a minority of the respondents used standardized articulation or phonological assessments. The majority of the respondents felt that the lack of locally developed standardized tests and the utilization of informal assessments of articulation and phonology in their clinics did not provide accurate diagnoses or intervention plans. They felt that there was a need for collecting phonological developmental data and creating articulation and phonology assessments for Malaysian children.

The second study was designed to identify characteristics of the consonant and vowel inventories of MalE as well as phonetic realizations of speech sounds, by investigating the speech production of ten adult Chinese speakers of MalE. The participants were asked to read a list of 206 single words which contained all expected MalE consonants, consonant clusters and vowels. These speech sounds were sampled in several different words and in different syllable-word positions. This study goes beyond previous studies of MalE phonology by using a quantitative auditory phonetic analysis. The characteristics observed were first categorized according to their frequency of occurrence and then further grouped into categories based on the possible influences of British English or American English as well as local Malaysian languages (Mandarin Chinese and Malay) and dialects. The interference patterns within MalE resulting from the influence of local languages and Chinese dialects were also discussed. The phonological features of MalE which converged with developmental phonological processes in SE children were explored. An understanding of the phonological features and realizations of MalE speech sounds is important because this will help speech-language pathologists to differentiate dialectal phonological features exhibited by MalE speaking children from phonological differences and disorders.

The third study which was also the major study of this thesis was designed to provide valid and reliable normative data for the phonological development of MalE speaking Chinese children between the ages of 3 and 7 years. This study provided a description of the children's phonological system in MalE in terms of i) age of acquisition of speech sounds, ii) speech sound accuracy and iii) phonological process use. 264 typically developing English speaking Malaysian Chinese children between the ages of 3 and 7 years were recruited to participate in this cross-sectional study. In a pilot study, eleven words were eliminated from the list used in the second study, leaving a list of 195 words which sampled consonants, consonant clusters and vowels in various syllable-word positions and phonotactic structures. The words were illustrated and presented colourfully in composite pictures to elicit a large and well-controlled single word speech sample. All the speech data gained were transcribed phonetically and analyzed quantitatively. The findings revealed that MalE children's speech sound accuracy was underestimated when MalE dialectal features were not taken into consideration. MalE speaking children exhibited phonological acquisition patterns that were both similar and different to SE. The differences found were mainly due to the cross-linguistic effects of Mandarin Chinese and Malay which were acquired at the same time by MalE speaking children. The influence of Mandarin Chinese and Malay appeared to accelerate or delay the phonological acquisition of MalE based on phonetic similarity theory.

The findings of the present study highlight the need to consider MalE dialectal features in the phonological analysis of MalE speaking children. The differences in phonological acquisition of MalE and SE indicate that the norms of SE are not suitable to be used for MalE speaking children. This study will provide useful and locally appropriate normative developmental data on phonological acquisition for MalE speaking Chinese children. Speech-language pathologists in Malaysia will be able to use it as a guideline in assessing and treating clients with articulation and phonological disorders. In addition, these normative developmental data are a prerequisite to the eventual establishment of a phonological assessment tool specifically designed for MalE.

PUBLICATIONS ARISING FROM THIS THESIS

Phoon, H. S., & Maclagan, M. A. (2009). A survey of Malaysian speech-language pathologists' perception of articulation and phonological assessments. *Asia Pacific Journal of Speech, Language and Hearing*, *12*(4), 315-332.

Phoon, H. S., & Maclagan, M. A. (2009). Chinese Malaysian English Phonology. *Asean Englishes*, *12*(1), 20-45.

Phoon, H. S., & Maclagan, M. A. (2009). *The Phonology of Malaysian English: A Preliminary Study*. In L. J Zhang, R. Rubdy & A. Lubna (Eds.) *Englishes and Literatures-in-English in a Globalised World*: *Proceedings of the 13th International Conference on English in Southeast Asia* (pp. 59-73). Singapore: National Institute of Education, Nanyang Technological University.

Phoon, H. S., & Maclagan, M. A. (2009). *The pronunciation features of Malaysian English*. Proceedings of The Language and Language Teaching Conference, Songkhla, Thailand.

PRESENTATIONS WITH PUBLISHED ABSTRACTS

Phoon, H.S., & Maclagan, M.A. (2010). Phonological Skills of Malaysian English Speaking Chinese Children. Poster presented at New Zealand Speech Therapists' Association Biennial Conference, Wellington, New Zealand, 22-23 April.

Phoon, H. S (2009). Consonant Acquisition of Malaysian English Speaking Chinese Children. The Postgraduate Research Conference of Communication Disorders Department. University of Canterbury, New Zealand, 12 November.

Phoon, H.S., & Maclagan, M.A. (2009). Vet and Wet: What does it mean for Malaysian English. The Linguistic Society of New Zealand 18th Biennial Conference, Palmerston North, New Zealand, 30 November – 1st December.

Phoon, H.S., & Maclagan, M.A. (2009). The Pronunciation Features of Malaysian English. Poster presented at The Language and Language Teaching Conference, Songkhla, Thailand, 14 August.

Phoon, H.S., & Maclagan, M.A. (2008). The Phonology of Malaysian English: A Preliminary Study. The 13th International Conference on English in Southeast Asia, Singapore, 4-6 December.

Phoon, H.S., & Maclagan, M.A. (2008). A Description of the Malaysian English Phonology. The 11th New Zealand Language and Society Conference, Dunedin, New Zealand, 17-18 November.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

MalE	Malaysian English
SE	Standard English
BrE	British English
AmE	American English
GAE	General American English
AAVE	African American Vernacular English
SLP	Speech-language pathologists
SI	Syllable initial position
SF	Syllable final position
SIWI	Syllable-initial word-initial
SIWW	Syllable-initial within-word
SFWF	Syllable-final word-final
SFWW	Syllable-final within-word
PCC	Percentage of Consonants Correct
PVC	Percentage of Vowels Correct
PCCC	Percentage of Consonant Clusters Correct
PPC	Percentage of Phonemes Correct
MSW	Monosyllabic word
DSW	Disyllabic word
PSW	Polysyllabic word
E	English
MC	Mandarin Chinese
M	Malay

CHAPTER 1
LITERATURE REVIEW

1.0 INTRODUCTION

Phonology is the component of language that is concerned with the rules governing the structure, distribution and sequencing of speech sounds and the shape of syllables (Owens, 2007). It is regarded as one of the major components of language, alongside morphology, syntax, semantics and pragmatics. Phonology encompasses two elements: overt and covert speech (Edwards & Shriberg, 1983). Overt speech is the formation or articulation of sounds, generated by the movement of speech muscles. Covert speech is the formulation of sound sequences based on the knowledge of the sound system. When a child does not develop the ability to produce some or all sounds necessary for speech that are normally used at his or her age, phonological disorder occurs. Phonological disorder is one of the most prevalent communication disorders diagnosed in the preschool and school age populations, affecting approximately 10% of children (NIDCD, 2000). Approximately 7-8% of children aged between 3 and 11 years old are diagnosed with articulation disorders and males are affected two to four times more often than their female peers (Encyclopedia of Mental Disorders, 2007). Approximately 90% of school speech-language pathologists (SLPs) treated children with articulation disorders in 2006 (ASHA, 2008). SLPs are interested in the study of normal phonological development for the purpose of differentiating normal and disordered children and for effective planning of intervention programmes. In describing the phonological systems of children, two procedures are commonly used: independent analyses and relational analyses (Stoel-Gammon & Dunn, 1985). An independent analysis describes the child’s individual system while a relational analysis compares the child’s system with the adult system.

Independent Analyses

Independent analyses usually focus on the child’s production by itself regardless of the relationship to the adult model. Studies that employ independent analyses discuss phonetic inventories of early meaningful speech as well as speech behaviours preceding the onset of meaningful speech such as vocalization and babbling. For instance, Stoel-Gammon (1985) studied the range and types of consonantal phones produced by 34 young children from 15 to 24 months; Dyson (1988) investigated word-initial and word-final phonetic inventories of consonant singletons and clusters of 2 and 3 year old children; Stoel-Gammon (1987) provided a profile of the phonological skills of 2 year-old children by studying the word and syllable shapes produced and the inventories of consonants; Robb and Bleile (1994) studied the number and types of consonants occurring in the children's inventories and the relative frequency of occurrence of sound classes of glossable and non-glossable utterances produced by seven children between the ages of 8 and 25 months. These studies are crucial in the account of children's phonological development as they provide data on the early period of meaningful speech development and can be used to establish preliminary norms regarding the emergence and use of early speech sounds. The only drawback in these studies using independent analysis is that they have been predominately longitudinal in nature and have been based on small samples of participants under 3 years old. This makes it difficult to use them clinically as valid normative data.

Relational Analyses

Relational analyses compare the child's correct and incorrect productions of a word with the standard adult form. The analysis of correct pronunciations is commonly used to establish norms of **speech sound acquisition** (Arlt & Goodban, 1976; Chirlian & Sharpley, 1982; Dodd, Holm, Hua, & Crosbie, 2003; Kilminster & Laird, 1978; Moyle, 2005; Poole, 1934; Porter & Hodson, 2001; Prather, Hedrick, & Kern, 1974; Smit, Hand, Bernthal, Freilinger, & Bird, 1990; Templin, 1957; Wellman, Case, Mengert, & Bradbury, 1931). The incorrect productions of children are compared with the adult forms in terms of error patterns or **phonological processes** (Dodd, et al., 2003; Dyson & Paden, 1983; Grunwell, 1981; Haelsig & Madison, 1986; Hodson & Paden, 1981; James, McCormack, & Butcher, 1999; James, 2001; Prater & Swift, 1982; Preisser, Hodson, & Paden, 1988; Roberts, Burchinal, & Footo, 1990; Schwartz, Leonard, Folger, & Wilcox, 1980; Vihman & Greenlee, 1987; Watson & Scukanec, 1997a, 1997b). There are numerous studies that have reported data of this type, and most of them are based on relatively large numbers of normally developing children who are usually 3 years or older. The age of acquisition of phonemes derived using relational analysis is one of the important benchmarks regularly used to determine the status of children's speech. Phonological process analysis is another commonly used method for identifying error patterns exhibited by children and is also based on relational analysis.

A phonological process or pattern is commonly defined as a systematic sound change or simplification that affects a class of sounds, or a particular sequence of sounds. Individual sound productions and error patterns are reviewed to determine if a child is using sounds and processes at a level appropriate to their age. Quantitative data such as **speech sound accuracy** (mean percentage of consonants correct, mean percentage of vowels correct, mean percentage of consonant clusters correct and mean percentage of phonemes correct) (Dodd, et al., 2003; Pollock, 2002; Waring, Fisher, & Atkin, 2001) which can be derived from the relational analysis is another important element in documenting the progress of children's phonological development over time. This information can be used to compare a child's performance with that of same-aged peers. A metric called percentage of consonants correct (PCC) was derived by Shriberg & Kwiatkowski (1982, 1997) to help judge the level of children's phonological performance. They recommended the calculation of percentage of consonants correct (PCC) as an index to quantify the severity of articulation performance. As no one single measure is sufficient to describe children's phonological abilities, the inclusion of i) speech sound acquisition, ii) phonological processes and iii) speech sound accuracy is necessary in studies of children's phonological development. The combination of these data provides more comprehensive information in clinical decision-making. These three aspects of phonological development will be reviewed in turn in the following sections.

1.1 Speech Sound Acquisition

Early research on phonological development emphasized phoneme acquisition using a segmental approach which deals with the analysis of speech into phonemes (or segmental phonemes). The focus of these studies was to establish norms for the order and age of speech sound acquisition of typically developing English speaking children. SLPs have extensively used this speech normative data in their practice to evaluate children with articulation and phonological disorders. It is important to know when speech sounds are learned in order to determine whether a child's speech is typical or not.

Table 1.1 summarizes the details of some well-known studies on age of acquisition. The focus of these studies was mainly the approximate ages at which sounds are established. All of these studies used a similar approach, single word naming, and tested large numbers of children from various age ranges. However, there were still substantial methodological and analytic differences, which led to discrepancies in the results. Different studies revealed different ages of acquisition (see Table 1.2). For instance, the normative data in Prather et al. (1974) and Arlt and Goodban (1976) demonstrated that children acquired speech sounds earlier than Poole (1934) and Templin (1957). The /s/ sound was acquired as early as 3;00 years old in Prather et al. (1974), but as late as 7;06 years old in Poole (1934). Similarly, the acquisition of /f/ ranged from 2;04 years old in Prather et al. (1974) to 5;06 years old in Poole (1934). The practical issue arising from inconsistencies in age of acquisition is which data set SLPs should use as a basis for assessment and treatment planning.

Smit (1986) reviewed and critiqued the differences in the normative studies and found the discrepancies were in: the number of participants; the age of the participants and age group intervals; the method used; the criteria for participants' inclusion; the examiners; the nature of the data and the analysis procedures. In the recruitment of participants, many studies only included typically developing children without articulation problems. Smit et al. (1990) and Moyle (2005) were the only two who considered both typically developing children and those with articulation problems as this sample distribution was believed to represent the population more closely as a base for developing norms. As for the age of the participants, the inclusion of a lower age group of children in Prather et al. (1974) and Chirlian & Sharpley (1982) led to the consistent earlier age of acquisition for the same sounds than in other studies. The differences in method used such as stimuli also partly accounted for the variation in age of acquisition of some sounds. The complexity of target words and familiarity of the vocabulary may have influenced the speech sound production (Ingram, Christensen, Veach, & Webster, 1980; James, van Doorn, & Mcleod, 2001; James, van Doorn, & McLeod, 2002). Ingram et al. (1980) revealed that production varied between words that are familiar and simple in structure and those that are unfamiliar and complex. Words with varying syllable numbers, stress and phonotactic shapes differentially affected the children's accuracy of consonant production (James, et al., 2002).

Table 1.1: Summary of the Studies of Age of Speech Sound Acquisition

Authors	Year	Country	Number of subjects	Age of Participants (Intervals)	Participants (SES Status)	Participants' Criteria		Sample type (Stimuli)	Number of Sounds (Items)	Word Positions	Phonemes Sampled			Criterion Used
						Normal	Articulation Problem				Consonant *(Total)	Vowel	Consonant Clusters	
Wellman et al.	1931	USA	204	2;00-6;11 (6 months)	Caucasians (Upper SES)	/	x	SW (questions/ pictures)	133	I, M, F	61	15	47	75% in 3 word positions
Poole	1934	USA	140	2;06-8;06 (6 months)	Caucasians (Upper SES)	/	x	SW (pictures/ objects/ actions)	23 (62)	I, M, F	23	-	-	100% in 3 word positions
Templin	1957	USA	480	3;00-4;11 (6 months) 5;00-8;11 (1 year)	Caucasians (SES represented urban population)	/	x	SW (pictures / reading)	176	I, M, F	66	19	48	75% in 3 word positions
Prather et al.	1974	USA	147	2;00-4;00 (4 months)	Caucasians (SES from 3 social classes)	/	x	SW (photographs)	25 (44)	I, F	25	-	-	75% in 2 word positions
Arlt &	1976	USA	240	3;00-6;11 (6 months)	Diverse racial representation	/	x	SW (pictures)	79 (48)	I, M, F	24 (66)	11	6	75% in 3 word

Goodban					(SES represented population)									positions
Kilminster & Laird	1978	Australia	1756	3;00-9;11 (6 months)	Caucasians (NA)	/	x	SW (photographs)	24 (64)	I, M, F	24	-	-	75% in 3 word positions
Chirlian & Sharpley	1982	Australia	1375	2;00-9;11 (6 months)	Aboriginal and Caucasians (random SES)	/	x	SW (photographs)	24 (64)	I, M, F	24	-	-	75% & 100% in 3 word positions
Smit et al.	1990	USA	997	3;00-9;11 (6 months)	Diverse racial representation (SES represented population)	/	/	SW (photographs)	108 (80)	I, F	23	-	27	75% in 2 word positions.
Porter & Hodson	2001	California	520	2;06-8;00 (1 year)	Diverse racial representation (NA)	/	x	SW (pictures/ objects/ questions)	(55)	I, F	24	-	31 (I, F)	85% level of acquisition
Dodd et al.	2003	Britain	684	3;00-6;11 (6 months)	Caucasians (SES represented population)	/	x	SW (pictures)	(30)	I, F	24	all	-	90% in 2 word positions
Moyle	2005	New Zealand	1013	5;00-8;11 (6 months)	Diverse racial representation (SES represented population)	/	/	SW (pictures)	(82)	I, M, F	24	-	23 (F)	90% in 3 word positions

SW - Single Word
/ - Criterion used
X - Criterion not used

The criteria used in defining age of acquisition was noteworthy, for the lack of consensus about the notion of the mastery of sounds and the level of clinical significance is one reason that contributes to variation (Dodd, 1995). The criterion of age of acquisition was either not clearly defined as in Smit et al. (1990) or varied from one study to another. The criterion of either 75% or 90% of the children producing the sound correctly in three word positions was commonly used (Poole, 1934; Templin, 1957; Wellman, et al., 1931). Sander (1972) deemed that the presentation of these data is insufficient to reflect the average performance of children as they indicate only upper age limits. He endeavoured to portray both median and upper age limits of children's acquisition in a graphic form using data from Wellman et al. (1931) and Templin (1957). Sander used the range of 50% of the children producing the sound correctly in two word positions as *age of customary production* and 90% of the children producing the sound correctly in three word positions as *age of mastery production* to reflect the continuum of sound acquisition. The classical definition of age of acquisition based on a definite age was also considered as inadequate by Shriberg (1993) who derived a developmental sound class classification based on the average percent correct in speech-delayed children. Phoneme acquisition was divided into three stages: early eight [m, b, j, n, w, d, p, h]; middle eight [t, ŋ, k, g, f, v, tʃ, dʒ] and late eight [ʃ, θ, s, z, ð, l, r, ʒ]. Goldman, Fristoe and Williams (2000) tried to avoid the issue of differences in criteria used in determining the age of acquisition by providing the raw data of speech sound acquisition derived from the Goldman-Fristoe Test of Articulation 2, so that SLPs could establish their own developmental criteria for each individual case or for their particular setting and use them to compare with data in past studies such as Templin (1957).

Many of these normative studies discussed the age of acquisition based on word position such as initial, medial and final positions (Arlt & Goodban, 1976; Chirlian & Sharpley, 1982; Kilminster & Laird, 1978; Poole, 1934; Prather, et al., 1974; Sander, 1972; Smit, et al., 1990; Templin, 1957; Wellman, et al., 1931). Word positions are described regardless of phonetic environment and syllable boundaries. For instance, /n/ sounds in the words sa<u>nd</u>wich (syllable-final within-word) and mo<u>n</u>ey (syllable-initial within-word) appear in different syllable positions, but a classical analysis would regard each of them as being word-medial. Grunwell (1982) attempted to establish a set of rules for describing four positions which could be used to represent both syllable and word position: syllable-initial, word initial (SIWI); syllable-initial, within-word

(SIWW); syllable-final, word-final (SFWF) and syllable-final, within-word (SFWW). A consideration of syllable and word positions will help to prevent the confusion caused by 'medial' word position. In addition to that, these normative studies did not discuss the acquisition of consonants according to word or syllable position separately, but depicted it based on the average of either 2 or 3 word positions (initial, medial and final) (Arlt & Goodban, 1976; Chirlian & Sharpley, 1982; Kilminster & Laird, 1978; Poole, 1934; Prather, et al., 1974; Sander, 1972; Smit, et al., 1990; Templin, 1957; Wellman, et al., 1931). There are many reports that demonstrate that developmental trends vary by phoneme and position. Farwell (1976) and Ferguson (1977) found that fricatives were produced more accurately in final position. Kent (1982) found that the /l/ sound in final position was prone to error as normal adult speakers occasionally produced postvocalic /l/ without contact. Waring et al. (2001) found that the acquisition of the /v/ and /θ/ sounds are affected by position within a word. The consonants /v/ and /θ/ are acquired first in medial position and then in word initial and final positions. When inspecting the data in normative studies, there are differences in the age of acquisition for some sounds in different word positions. For example, in Templin (1957), /l/ in word-initial and medial positions was acquired at age of 4 years but /l/ in word-final was only acquired at 6 years. When the method of averaging 3 word positions (initial, medial and final) was used, /l/ was considered acquired only at 6 years old. Thus, children's ability to acquire the /l/ sound might be underestimated in such circumstances, when in fact, /l/ in initial and medial positions was acquired as early as four years old. Therefore, it is advisable that age of speech sound acquisition should be shown separately according to different syllable positions instead of portraying them based on the classical way of averaging two or three word positions.

Not all the normative studies analyzed and reported all three aspects of speech sounds: consonants, vowels and consonant clusters. Relatively speaking, consonants attracted more attention from scholars than vowels and consonant clusters. An overview of the consonant acquisition is shown in Table 1.2. Although discrepancies were encountered across these studies, some consensus was found. For instance, nasals, stops and glides were acquired relatively early; fricatives and affricates were mastered relatively late (Prather, et al., 1974; Smit, et al., 1990; Templin, 1957). Stops, nasals, glides, palatal fricatives and affricatives were acquired earlier as compared to alveolar and dental fricatives (Chirlian & Sharpley, 1982; Kilminster & Laird, 1978). Vowels have been less extensively investigated, primarily because they are particularly difficult to transcribe reliably and thus difficult to characterize (Vihman, 1992). Smit et al. (1990) excluded vowels in their normative study as they felt that vowel errors were scarce by the age of 3. In cross-sectional investigations on norms of speech sound acquisition, only two studies reported the age of vowel acquisition (Templin, 1957; Wellman, et al., 1931) (Table 1.3). Both studies revealed that vowel mastery is only completed by age of 4 years old. Three studies considered and investigated the age of consonant cluster acquisition (Table 1.4). Wellman et al. (1931) and Templin (1957) reported the age of acquisition of consonant clusters in both syllable initial and final positions, while Smit et al. (1990) only described the age of consonant cluster acquisition in syllable initial position and separated the discussion of consonant cluster acquisition according to sex.

The need to establish norms for non-American children arose in the late 1970s due to the urge to develop more current and representative speech sound acquisition data for specific populations, for instance, Australia (Chirlian & Sharpley, 1982; Kilminster & Laird, 1978), California (Porter & Hodson, 2001), the United Kingdom (Dodd, et al., 2003) and New Zealand (Moyle, 2005). The variation in the existing normative data led to difficulty in determining eligibility criteria for speech therapy treatment, so it is important to obtain local phonological acquisition data (Porter & Hodson, 2001). The establishment of local norms is a solution to avoid the discrepancies found in past studies and to provide reliable and valid data for the local population. The normative studies done in the 1990s and 2000s were more comprehensive (Dodd, et al., 2003; Moyle, 2005; Porter & Hodson, 2001; Smit, et al., 1990). This is because methodological aspects such as sampling procedures, elicitation procedures, and adequacy of responses as well as methods of analyzing and reporting the results (e.g. the effects of demographic variables, sex and socio-economic status in relation to speech sound acquisition) were more carefully described in these recent studies compared to the previous studies.

Table 1.2: Age of Acquisition for Consonants

Authors	Wellman et al. (1931)	Poole (1934)	Templin (1957)	Prather et al. (1975)	Arlt & Goodban (1976)	Kilminster & Laird (1978)	Chirlian & Sharpley (1982)	Smit et al. (1990)		Porter & Hodson (2001)	Dodd (2003)
Age Range / Phonemes	2;00-6;11	2;06-8;06	3;00-8;11	2;00-4;00	3;00-6;11	3;00-9;11	2;00-9;11	3;00-9;11		2;06-8;00	3;00-6;11
								F	M		
p	4;00	3;06	3;00	2;00	3;00	3;00	2;06	3;00	3;00	3;00	3;00
b	3;00	3;06	4;00	2;08	3;00	3;00	3;06	3;00	3;00	3;00	3;00
t	5;00	4;06	6;00	2;08	3;00	3;00	3;06	3;00	3;00	3;00	3;00
d	5;00	4;06	4;00	2;04	3;00	3;00	2;06	3;00	3;00	3;00	3;00
k	4;00	4;06	4;00	2;04	3;00	3;00	3;00	3;00	3;00	3;00	3;00
g	4;00	4;06	4;00	3;00	3;00	3;00	2;06	3;00	3;00	3;00	3;00
m	3;00	3;06	3;00	2;00	3;00	3;00	2;00	3;00	3;00	3;00	3;00
n	3;00	4;06	3;00	2;00	3;00	3;00	2;00	3;00	3;00	3;00	3;00
ŋ	3;00	3;06	3;00	2;00	3;00	3;00	2;06	5;06	6;00	3;00	3;00
f	3;00	5;06	3;00	2;04	3;00	3;06	3;00	3;00	3;06	3;00	3;00
v	5;00	6;06	6;00	X	3;06	6;00	8;06	4;00	4;06	3;00	3;00
θ	X	7;06	6;00	X	3;00		7;06	5;06	6;00	3;00	X
ð	X	6;06	7;00	4;00	5;00	8;00	7;06	4;00	5;06	3;00	X
s	5;00	7;06	4;06	3;00	4;00	4;06	4;00	3;00	5;00	3;00	3;00
z	5;00	7;06	7;00	X	4;00	4;06	X	5;00	6;00	3;00	3;00
ʃ	5;00	6;06	4;06	3;08	4;06	4;00	3;00	4;00	5;00	3;00	5;00
ʒ	5;00	6;06	7;00	4;00	4;00	3;00	4;00			3;00	4;00
h	3;00	3;06	3;00	2;00	3;00	3;00	2;00	3;00	3;00	3;00	3;00
tʃ	5;00		4;06	3;08	4;00	4;00	3;06	4;00	5;00	3;00	4;00
dʒ	6;00		7;00	X	4;00	4;06	3;06	4;06	4;00	3;00	4;00
w	3;00	3;06	3;00	2;08	3;00	3;00	2;06	3;00	3;00	3;00	3;00
j	4;00	4;06	3;06	2;04		3;00	3;00	3;06	3;06	3;00	3;00
l	4;00	6;06	6;00	3;04	4;00	4;00	4;00	4;06	6;00	5;00	3;00
r	5;00	7;06	4;00	3;04	5;00	5;00	5;00	6;00	5;06	6;00	6;00

Grey - Not tested or reported.
X - Tested but did not reach the mastery criterion.

Criteria:

- Age norms for consonants were established at the 75% level by all these studies except for studies done by Poole (1934), Porter and Hodson (2001) and Dodd et al. (2003) that used 100%, 85% and 90% level respectively.
- All these studies averaged the percentages from the three word positions with the exception of Prather et al. (1975), Smit et al. (1990) and Dodd's et al. (2003) studies which considered only two word positions as well as Porter and Hodson (2001) who did not specify.
- Smit et al. (1990) separated the data for female and male due to the significant difference of sex in consonantal acquisition.

Table 1.3: Age of Acquisition for Vowels

Vowels	Wellman et al. (1931)	Templin (1957)	Vowels	Wellman et al. (1931)	Templin (1957)
u	2;00	3;00	ʌ	2;00	3;00
ʊ	4;00	3;00	ɜ	2;00	3;00
ɔ	3;00	4;00	ə	2;00	3;06
ɒ	4;00	3;00	əʊ	2;00	3;00
i	2;00	3;00	aɪ	3;00	3;00
ɪ	4;00	3;00	oɪ	3;00	3;00
ɛ	3;00	3;00	aʊ	3;00	3;00
æ	4;00	3;00	eɪ	4;00	3;00
ɑ	2;00		ju	3;00	3;00

Grey - Not tested or reported

Criteria:

Age norms for vowels were established at the 75% level by Wellman et al. (1931) and Templin (1957).

Table 1.4: Age of Acquisition for Consonant Clusters

Syllable Position	Consonant Clusters	Wellman et al. (1931)	Templin (1957)	Smit et al. (1990)	
				F	M
Syllable Final	tw, kw	4;00-5;00	4;00	3;06	3;06
	sp, st, sk	5;00	4;00*	4;06	5;00-6;00*
	sm, sn	5;00	4;00*	5;06	5;00*-7;00
	sw	5;00	7;00	4;06	6;00
	sl	5;00	7;00	6;00	7;00
	pl, bl, kl, gl, fl	5;00	4;00-5;00	4;00-4;06	4;00-5;06
	pr, br, tr, dr, kr, gr	5;00	4;00*-4;06	4;06*-6;00	5;00*-6;00
	fr, θr	6;00	7;00	7;00	7;00
	skw	5;00	6;00	4;06*	7;00
	spl	5;00	7;00	6;00	7;00
	spr, str, skr	5;00	5;00-7;00	8;00	8;00
Syllable Initial	lf		4;06		
	lt, lk	5;00	4;00-6;00		
	mp	3;00	3;06		
	nt, nd, ŋk	4;00-6;00	3;00-6;00		
	ns	5;00			
	ft		4;00		
	ks	5;00	3;06		

Grey - Not tested or reported

* A reversal occurs at older age groups.

Criteria:

- Age norms for consonant clusters were established at the 75% level by Wellman et al. (1931) and Templin (1957). Smit et al. (1990) did not specify.
- Wellman et al. (1931) and Templin (1957) averaged the percentages from the three word positions with the exception of Smit et al.'s study (1990) which considered only two word positions.
- Smit et al. (1990) separated the data for female and male due to the significant difference of sex in consonant cluster acquisition.

1.2 Phonological Processes

There was a shift in the description of children's speech from a segmental approach to a phonological process approach after Stampe (1969) introduced the theory of natural phonology. However, when combined with earlier normative studies of speech sound development, both sets of data can be very useful in the evaluation of children's phonological development, and thus provide more comprehensive evaluation reports. The theory of Natural Phonology proposed by Stampe (1969) has had a significant role in the development of phonology. The original definition of this concept was: "A phonological process merges a potential opposition into that member of the opposition which least tries the restrictions of the human speech capacity" (Stampe, 1969:443). "A phonological process is a mental operation that applies in speech to substitute for a class of sounds or sound sequences presenting a common difficulty to the speech capacity of the individual, an alternative class identical but lacking the difficult property" (Stampe, 1979:1). The theory proposes that phonology is based on a set of universal phonological processes, which interact with each another; some are active and some are suppressed. When children learn to produce adult words, they simplify the patterns of words in a way that is manifested by an innate universal system of phonological processes regardless of language. Once their production abilities and perception of the adult system improve, children gradually eliminate these simplification rules one by one using suppression.

Various classification systems of phonological processes have been developed (Hodson, 1980; Ingram, 1981; Khan, 1982; Shriberg & Kwiatkowski, 1980; Stoel-Gammon & Dunn, 1985; Weiner, 1979). In general, phonological processes can be divided into three categories: i) syllable structure, ii) assimilation or harmony and iii) substitution. Syllable structure processes produce changes in the constitution of the syllables of standard adult forms. For instance, weak syllable deletion, cluster reduction, final consonant deletion and glottal replacement (Weiner, 1979). Assimilation or harmony processes are the process that occur when an earlier sound influences a later one or vice versa (Khan, 1982). The processes within this category include labial, alveolar and velar assimilation. Substitution processes involve replacement of one sound by another sound without being influenced by the surrounding phonemes. Examples of substitution processes are stopping, fronting, backing and gliding.

Examination of the types of error that occur in children's phonological development showed that children's productions were related to the adult forms in systematic ways. The use of phonological process analysis provides a simple and economical way of describing the differences in the structural and segmental aspects of a child's phonology (Stoel-Gammon & Dunn, 1985). This phonological process approach, therefore, became the most common procedure in describing children's phonological acquisition, and phonological rules were derived to describe the relationships (Smith, 1974). Ever since, many researchers have used phonological process analysis to describe the speech pattern of both normal and disordered children (Grunwell, 1985; Hodson, 1980; Ingram, 1981; Shriberg & Kwiatkowski, 1980; Stoel-Gammon & Dunn, 1985; Weiner, 1979). Two methods are usually employed in the studies of phonological processes: longitudinal and cross-sectional. Both methods have their strengths and limitations and are able to complement each other in providing rich and valuable information about children's phonological development. Table 1.5 summarizes both longitudinal and cross-sectional studies of phonological processes.

1.2.1 Longitudinal Studies of Phonological Processes

Single-word elicitation procedures which are often used in cross-sectional studies described below are claimed to be less representative of children's habitual speech. In view of this limitation, some researchers were interested to observe the phonological skills of children over time in natural contexts (Dodd, 1995; Klein, 1985; Schwartz, et al., 1980; Vihman & Greenlee, 1987; Watson & Scukanec, 1997a, 1997b). Conversational speech elicited in a play setting is especially suitable for young children who are not able to comply with the more structured single word elicitation methods. Due to the nature of longitudinal studies, the majority of these studies involved a small number of younger children below 3 years. The developmental patterns of process usage under age 3 years in the longitudinal studies complement data from the cross-sectional studies with older children. For example, vowel and consonant cluster errors of young children are seldom studied cross-sectionally but are usually included in longitudinal studies. Longitudinal studies that described vowel errors included individual children (Davis & MacNeilage, 1990; Hargrove, 1982) and small numbers of children (Bleile, 1989; Dodd, 1995; Pollock & Keiser, 1990). These studies are useful as they report on young children's patterns of vowel errors. Dodd (1995), for instance, found three consistent patterns (substitution of neutral unrounded vowels [ʌ] and [ə], lengthening and/or rounding of vowels before final-consonant deletion and vowel harmony) emerged in the production of 20-26 months old children. Consonant cluster errors such as cluster reduction, cluster simplification, epenthesis, metathesis and coalescence were also described in longitudinal studies (Dodd, 1995; Dyson & Paden, 1983; Watson and Scukanec, 1997a). Cluster reduction is one of the most extensively described phonological processes. Cluster reduction was reported in five children aged between 20-36 months (Dodd, 1995). Cluster reduction was frequent in young children between 1;11 – 2;11, ranging from 30.18% - 49.63% (Dyson & Paden, 1983). Consonant cluster simplification and reduction were also reported in Watson and Scukanec (1997a). The findings of the above studies reflected the types and frequency of errors that were apparent in young children but did not contain any information about the age when the errors were suppressed. Cross-sectional studies are most likely to provide such necessary information.

1.2.2 Cross-sectional Studies of Phonological Processes

There are a considerable number of cross-sectional studies on phonological processes, but only a few studies have specifically focused on the age levels at which phonological processes normally occur and are suppressed (Bankson & Bernthal, 1990; Dodd, et al., 2003; Grunwell, 1981; Haelsig & Madison, 1986; James, 2001; Roberts, et al., 1990). This is because others have included information about phonological processes among details of other aspects of phonological development. For example, a number of studies compared the phonological process usage for both normal and disordered children (Hodson & Paden, 1981; Ingram, 1976). Some researchers test hypotheses rather than establishing normative data. For instance, Prater & Swift (1982) made an attempt to test Stampe's (1969) hypothesis about the development of phonological processes using Mean Length Utterances (MLU) and chronological age for classifying the participants.

Substantial variations in findings were observed in studies that focus on the age levels at which phonological processes normally occur and are suppressed. The age at which the phonological processes of consonants are suppressed is summarized in Table 1.6. More than 20 phonological processes are described. Some processes frequently occur across all six studies while some are only noted in one of the studies. For instance, liquid gliding, fronting, stopping and weak syllable deletion were reported in all six studies. Less commonly reported phonological processes were palatalization, initial consonant deletion, metathesis and backing. Although the age at which the phonological processes were suppressed was different, some commonalities were still found across studies. For example, fronting and stopping disappeared around 3 years old; weak syllable deletion and final consonant deletion usually did not persist after 4 years and liquid gliding was usually suppressed at 5 years.

None of the large scale studies reported on types of vowel errors and the age when vowel errors were suppressed. Pollock (2002) conducted a large scale study of vowel errors in 283 children with normal and disordered phonological development. The specific vowels in error were identified in this study, but the types of error patterns were not described in detail. The age when cluster reduction was suppressed was reported in large scale cross-sectional studies such as Grunwell (1981), Haelsig & Madison (1986), Roberts et al. (1990), Bankson & Bernthal (1990) (1990), James (2001) and Dodd et al. (2003). This information is compiled in Table 1.7. The age when cluster reduction was suppressed varied greatly from one study to another, ranging from 3 to 7 years. Cluster reduction was suppressed as early as 3 years in Grunwell, but as late as 7 years in Roberts et al.. This is probably because of the differences in methodological aspects. The limitations in methodological aspects need to be overcome in order to obtain fully representative data on phonological processes.

First, the criteria for phonological process analysis should be clearly defined. The majority of the early studies used surface analysis procedures with no quantitative criteria to demonstrate the presence of processes, for example, Hodson & Paden (1981) and Preisser et al. (1988). Quantitative criteria were used in more recent studies, but different thresholds were set. For example, the criterion for use of phonological process occurrence was 20% of the time in Roberts et al. (1990) and 10% of the time in Dodd et al. (2003). According to McReynolds & Elbert (1981a), if a phonological process analysis is conducted within the framework of a specific theory, for instance, natural phonology (Stampe, 1969), the conditions set forth within the theory should be satisfied. When McReynolds & Elbert employed surface (or non-quantitative) and quantitative phonological process analysis on 13 children with functional articulation problems, there was a great difference in terms of the number of phonological patterns identified with and without quantitative criteria imposed. Thus, there is a need to establish standardized quantitative and qualitative criteria for phonological process identification by determining the percentage frequency of occurrence and the percentage of children using the phonological processes.

Table 1.5: Cross-sectional and Longitudinal Studies of Phonological Processes

Authors	Year	Country	Number of subjects		Age of Participants (Intervals/)	Data Collection	Sample type (Stimuli)	Test/ Materials	Criterion Used	
			Normal	Disordered					Age Group	Occurrence of Tokens
Schwarts et al.	1980	USA	3	3	1;07 – 1;09	Longitudinal	Conversation (play)	Toys, books	At least 2 children	2 occurrences to be considered productive
Grunwell	1981	USA	15	15	0;9-4;06	Compilation	-	-	-	-
Hodson & Paden	1981	USA	60	60	4;00-4;11	Cross-sectional	Single word (Objects)	The Assessment of Phonological Processes (Hodson, 1980)	3 levels Level 1: 50-60 Level 2: 30-40 Level 3: 5-20	NA
Prater & Swift	1982	USA	60	0	1;09-4;00	Cross-sectional	Single word (Pictures)	The Phonological Process Analysis (Weiner, 1979)	-	Mean usage: divided into < or > 20%
Dyson & Paden	1983	USA	40	0	1;11 – 2;11	Longitudinal	Single word (Objects/ Questions)	Objects	NA	NA
Haelsig & Madison	1986	USA	50		2;10-5;02	Cross-sectional	Single word (Pictures)	The Phonological Process Analysis (Weiner, 1979)	20%	20%

Vihman & Greenlee	1987	USA	10		0;9 3;00	Longitudinal	Conversation (play)	Toys, books	NA	Sporadic (<25%) Inconsistent (25% - 75%) Regular (> 75%)
Preisser, Williams & Paden	1988	USA	60		1;06-2;05 (4 months)	Cross-sectional	Single word (Objects)	-	NA	NA
Roberts et al.	1990	USA	145		2;06-8;11 (6 months)	Cross-sectional	Single word	Goldman-Fristoe Test of Articulation (1969)	10%	20%
Watson & Scukanec	1997a	USA	12		2;00 3;00 (3 months)	Longitudinal	Conversation (play)	-	NA	20%
Watson & Scukanec	1997b	USA	12		2;00 3;00 (3 months)	Longitudinal	Conversation (play)	-	NA	20%
James et al.	1999	Australia	240		5;00-7;11	Cross-sectional	Single word (Pictures)	-	Categorized into 0-5, 6-10, 11-20, 21-39, 31-50, 51-99, 100	MPU 0 – 0.9, 1 – 4.9, 5 – 9.9, +10
James	2001	Australia	50		2;0-7;11	Cross-sectional	Single word (Pictures)	-	50%	50%
Dodd et al.	2003	Britain	684		3;00-6;11 (6 months)	Cross-sectional	Single word (Pictures)	DEAP (2002) - The Phonological Assessment	10%	Occur at least 5 times (twice in the case of weak syllable deletion)

Table 1.6: The Age at Which the Phonological Processes of Consonants are Suppressed

Authors	Grunwell (1981)	Haelsig & Madison (1986)	Roberts et al. (1990)	Bankson & Bernthal (1990)	James (2001)	Dodd et al. (2003)
Age Range / Phonological Processes	0;09-4;06	2;10-5;02	2;06-8;11	3;00-6;11	2;00-7;11	3;00-6;11
Liquid gliding	< 4;00	4;06	5;00	5;00	5;00*	6;00
Fronting	3;03	3;00	3;06	< 3;00	> 6;00	4;00
Stopping	3;00	3;00	3;00	5;00	4;00	3;06
Unstressed syllable deletion	4;00	5;00	< 2;06	4;00	4;00	4;00
Final consonant deletion	3;03	3;06	< 2;06	4;00	4;00	X
Deaffrication	X	X	3;06	< 3;00	4;00	5;00
Affrication	X	3;00	X	X	3;00	X
Alveolar assimilation	X	3;00	X	X	4;00	X
Velar assimilation	X	3;00	X	X	> 6;00	X
Prevocalic devoicing	X	3;00	X	X	3;00	X
Postvocalic devoicing	X	3;00	X	X	4;00	X
Glottal replacement	X	4;00	X	X	5;00	X
Consonant harmony	2;06	X	X	< 3;00	X	X
Depalatalization	X	X	X	< 3;00	5;00*	X
Context sensitive voicing	2;06	X	X	X	X	X
Reduplication	2;06	X	X	X	X	X
Labial assimilation	X	3;06	X	X	X	X
Denasalization	X	3;00	X	X	X	X
Fricatives gliding	X	3;00	X	X	X	X
Vocalization	X	X	X	5;00	X	X
Backing	X	X	X	X	4;00	X
Metathesis	X	X	X	X	6;00*	X
Initial consonant deletion	X	X	X	X	4;00	X
Palatalisation	X	X	X	X	4;00	X

X - Not tested or reported

* Phonological processes were suppressed at a younger age and reappeared, reflecting their fluctuating distribution.

Criteria:

- Grunwell (1981) – the criteria for phonological process suppression were not stated.
- Haelsig & Madison (1986) - the age at which a process occurred in less than 20% of the sample who used a particular process 20% of the time or more.
- Roberts et al. (1990) - the age at which a process occurred in less than 10% of the sample who used a particular process 20% of the time or more.
- Bankson & Bernthal (1990) - a process used by 10% of the population.
- James (2001) - a decrease in occurrence of process that was used by more than 50% of the children in any age cohort by 50% or more.
- Dodd et al. (2003) - a process used by 10% of the population at least 5 times for all processes described except 2 times for unstressed syllable deletion.

Table 1.7: Age at Which the Phonological Processes of Consonant Clusters are Suppressed

Phonological Processes	Grunwell (1981)	Haelsig & Madison (1986)	Roberts et al. (1990)	Bankson & Bernthal (1990)	James (2001)	Dodd et al. (2003)
	Age Range					
	0;09-4;06	2;10-5;02	2;06-8;11	3;00-6;11	2;00-7;11	3;00-6;11
Cluster reduction	3;00	3;06	7;00	> 6;00	4;00	5;00
Epenthesis	X	X	X	X	6;00	X

X - Not tested or reported

Criteria:

- Grunwell (1981) – the criteria for phonological process suppression were not stated.
- Haelsig & Madison (1986) - the age at which a process occurred in less than 20% of the sample who used a particular process 20% of the time or more.
- Roberts et al. (1990) - the age at which a process occurred in less than 10% of the sample who used a particular process 20% of the time or more.
- Bankson & Bernthal (1990) - a process used by 10% of the population.
- James (2001) - a decrease in occurrence of process that was used by more than 50% of the children in any age cohort by 50% or more.
- Dodd et al. (2003) - a process used by 10% of the population at least 5 times.

Second, the number of children should be large enough to reflect the actual population. Grunwell (1981) compiled the data from case studies done by Ingram (1976) and presented a profile of phonological development in children at the stage of first word use (9 to 18 months) to 4 years old with an inclusion of the chronology of the suppression of phonological processes. Due to the limited number of children in the study, great individual variation was noted and it is hard to generalize the findings to the general population. Similarly, James (2001) recruited only 50 children aged 2 to 7 years old while establishing the phonological process developmental data for normal children and again great variability was found. Thus, more larger-scale studies are required to authenticate the findings of previous smaller-scale studies.

Third, children with a wider age range should be included in order to examine when the phonological processes are fully suppressed. For instance, cluster reduction persists until 6 years old (Bankson & Bernthal, 1990), but little information is available about when such processes fully disappear or are suppressed due to the age limit of the participants. Cluster reduction was found to be suppressed by 7 years in Roberts et al.

(1990)'s study when the upper age limit of participants was increased to 8 years old. Haelsig & Madison (1986) considered only 3 to 5 year- old normal children because phonological processes are reported to be eliminated or suppressed by or before age 4 years (Grunwell, 1981). Preisser et al. (1988) felt that studies in younger groups of children may reveal trends that are not evident in older groups. They recruited children aged 1;06 to 2;05 in order to inspect the emergence of phonological patterns that might not be demonstrated by older children. On the other hand, James et al. (1999) studied children's use of phonological processes in the age range of 5 to 7 years in view of the scarcity of studies on phonological processes for children older than 5 years.

Fourth, test items should reflect an appropriate proportion of monosyllabic (MSWs), disyllabic (DSWs) and polysyllabic words (PSWs) (James, et al., 1999). Klein (1981) found that children's lexicons contain approximately 20% of PSWs. Therefore, PSWs should be included in phonological process analysis to ensure valid and reliable testing of children's speech skills. Klein (1985) noted that children's approach to the production of PSWs was suggestive of their later production skills for continuous speech. Young (1991) found that there was an interaction between the number of syllables and syllable deletion in young children. Much of the literature indicated that vowel errors are apparent only in DSWs and PSWs, especially with schwa in unstressed syllables in DSWs and PSWs. For instance, Paschall (1983) found that vowels in the second syllable of DSWs for 16-18 month old children were likely to be incorrect. Davis and MacNeilage (1990), who looked into the vowel errors of a child from 14 to 20 months with normal phonological development, revealed a high rate of vowel errors at this age and showed vowel errors were strongly related to word structure variables (monosyllabic versus disyllabic) including stress patterns of DSWs. Vowel errors in weak syllable in PSWs were also reported by Allen and Hawkins (1980) and by Young (1991). Children at age 3 years had difficulty producing weak syllables, and tended to substitute a full vowel for schwa. James (2001), who studied the vowel production of 354 children aged 3 to 7 years old across MSWs, DSWs and PSWs, discovered a similar finding, where many vowel errors were associated with the production of schwa in weak syllables in PSWs.

Fifth, the developmental data on phonological processes should represent a specific population for the purpose of validity and reliability. Apart from studies done on American children, studies on Australian and British children were reported recently. James (2001) felt that there was a need to investigate the development of phonological processes for Australian children as limited resources were available. Dodd et al. (2003) obtained a large representative sample of British children's phonological processes to establish reliable and representative normative data for clinical use.

1.3 Speech Sound Accuracy

Speech sound accuracy is measured using the mean percentage of scores in many phonological studies (Bankson & Bernthal, 1990; Templin, 1957; Wellman, et al., 1931). Consonant accuracy, for example, is indicated by the mean percentage of consonants. However, the validity of this measurement is uncertain in reflecting speech sound accuracy. Because of this, Shriberg & Kwiatkowski (1982) developed a metric called Percent Consonants Correct (PCC) for quantifying the severity involvement of children with a developmental phonological disorder. PCC is computed based on the number of consonants correct over the total number of consonants produced. A value can also be computed for individual consonants or a group of similar consonants. Four levels of severity of involvement are indexed based on PCC values: mild (85%), mild-moderate (85-65%), moderate-severe (65-50%), and severe (<50%). The metric is utilized as one element of a diagnostic classification system for phonological disorders and serves as a framework in managing individuals with phonological disorders (Shriberg & Kwiatkowski, 1982). PCC is commonly reported in many recent studies of normal phonological development (Bankson & Bernthal, 1990; Dodd, et al., 2003; Waring, et al., 2001) and also has been computed for earlier studies such as Wellman et al. (1931) and Templin (1957). Although the original development of PCC was based on a continuous speech sample, it is now widely used with single word speech samples, as single word naming is deemed to be more practical, simple and time efficient (Bankson & Bernthal, 1990; Dodd, et al., 2003; Waring, et al., 2001). Following the widespread use of PCC, Percentage of Vowels Correct (PVC), Percentage of Consonant Clusters Correct (PCCC) and Percentage of Phonemes Correct (PPC) are also used in profiling the children's phonological abilities. Speech sound accuracy measures such as PCC, PVC and PCCC are occasionally included as part of the measurements in studies of children's phonological development.

The level of consonant accuracy has been reported in both longitudinal and cross-sectional studies. In a longitudinal study done by Watson and Scukanec (1997b), the mean PCC for 12 children at 2;00 years old was 69.2%, at 2;06 years old was 75.09% and by 3;00 years old it increased to 86.17%. This finding showed that the accuracy of consonants increased when age increased. James et al. (2002) studied mean PCC for 354 children aged 3 to 7 years across MSWs, DSWs and PSWs and found that the PCC increased with age regardless of the type of syllables until the age group of 6 years. However, there was an effect from the type of syllables on the accuracy of consonant production for 6 and 7 year olds even though there was no age effect. This finding implies that up to 6 years old, children are still acquiring control over the paradigmatic aspects of consonants. The accuracy of consonant production for larger numbers of children with wider age ranges is shown in Table 1.8. Wellman et al. (1931) and Templin's studies (1957) showed comparable findings while Dodd et al. (2003) and Waring et al. (2001) revealed analogous results. The PCC over the age groups in Wellman et al. and Templin's studies was lower relative to the studies done by Dodd et al. and Waring et al.. However, the PCC increased steadily over the age groups across all four studies. The results of these studies indicate that consonantal development is still taking place after 3 years old.

Table 1.8: Percentage of Consonants Correct (PCC)

Authors	2;0	2;6	3;0	3;6	4;0	4;6	5;0	5;6	6;0	6;6	7;0	7;6
Wellman et al. (1931)	39.8 (9.6)		68.4 (11.1)		77.7 (11.1)		88.9 (4.4)		87.8 (8.1)			
Templin (1957)			57.8	66.9	75.2	78.2	80.04		88.41		92.7	
Bankson & Bernthal (1990)			88.3		92.3		96.7		97.2			
Dodd et al. (2003)			82.1 (13.0)		90.4 (9.05)			95.9 (5.2)				
Waring et al. (2001)				85.5 (7.4)	88.5 (4.8)		93.4 (3.0)		95.1 (2.4)		98.4 (1.2)	

( ) – Standard Deviation

The mean PVC has been described in many studies of young children. In Paschall's (1983) study, the mean PVC for 20 children aged 16-18 months was 59%. This finding coincides closely with Davis and MacNeilage (1990) who studied the acquisition of correct vowel production in a child over the period from 14 to 20 months and found that the child produced less than 60% of her vowels correctly. The findings demonstrated that vowel accuracy was low for young children and the development of vowels was not yet completed by 2 years old. Another noteworthy finding about the accuracy of vowels was related to the number of syllables in words. James et al. (2001)

found that children’s PVC scores were generally higher in MSWs and DSWs compared to PSWs. For example, the mean PVC scores for age 3 were 94.90% for MSWs, 94.81% for DSWs and 88.28% for PSWs. These findings highlight the need to assess vowel production in PSWs so as to state clearly the variability in a child’s vowel system. The mean PVC for children older than 24 months has been reported in large scale cross-sectional studies such as Wellman et al. (1931), Templin (1957), Pollock (2002) and Dodd et al. (2003). The summary of the PVC in these four studies is shown in Table 1.9. Templin, Pollock and Dodd’s findings demonstrated a similar trend, where the PVC was high (over 90%) for children as young as 3 years old and there were trivial increments in production accuracy over the age range studied. An age ceiling effect was thus noted in these young children. Near perfect accuracy was reported for the age group of 6 years old or older. Wellman et al. reported a noticeably different finding compared to the other studies, in that vowel accuracy was much lower for all age groups, for instance, 75.2% for 3 years old and 86.4% for 6 years old.

Table 1.9: Percentage of Vowels Correct (PVC)

Authors	2;0	2;6	3;0	3;6	4;0	4;6	5;0	5;6	6;0	6;6	7;0	7;6
Wellman et al. (1931)	68.2 (1.56)		75.2 (1.74)		80.2 (1.49)		88.9 (1.42)		86.4 (1.49)			
Templin (1957)			93.5	95.9	96.9	96.5	97.7		99.4		100.0	
Pollock (2002)	92.4 (5.49)	93.9 (6.39)	97.3 (3.02)	97.2 (2.23)	98.1 (2.21)	98.2 (1.78)	99.2 (0.85)	99.4 (0.77)	98.5 (1.29)	99.2 (0)		
Dodd et al. (2003)			97.4 (3.96)		98.9 (1.63)			99.2 (1.89)				

( ) – Standard Deviation

PCCC has been reported both in longitudinal and cross-sectional studies. In a longitudinal study of two-year-old Australian children, an overall 31.5% of consonant clusters were correctly produced in connected speech. Word-final consonant clusters were likely to be correct, followed by word-initial fricatives clusters and eventually word-initial stop clusters (McLeod, van Doorn, & Reed, 2002). Older children tend to produce consonant clusters more correctly, for instance, Shriberg and Kwiatkowski (1980) reported 90% correct production of clusters by age 4. Large scale cross-sectional studies that reported the accuracy of consonant cluster production (Templin, 1957; Waring, et al., 2001; Wellman, et al., 1931) are compiled and shown in Table 1.10. PCCC was low for children younger than 4 years old in the studies conducted by Wellman et al. and Templin. This is because consonant clusters are difficult to produce and young children tend to make more errors. Therefore, a low accuracy of consonant cluster production for young children is to be expected. Nonetheless, Waring et al. reported a relatively higher mean of PCCC (86.4%) at age of 3;5-3;11. PCCC in all three studies showed increments from 2 to 7 years old, indicating the development of consonant clusters is still occurring within this period.

Table 1.10: Percentage of Consonant Clusters Correct (PCCC)

Authors	2;0	2;6	3;0	3;6	4;0	4;6	5;0	5;6	6;0	6;6	7;0	7;6
Wellman et al. (1931)	10.9 (9.1)		51.8 (11.6)		73.2 (7.3)		87.2 (6.4)		91.5 (3.5)			
Templin (1957)			41.6	62.5	73.5	74.1	82.0		85.8		95.5	
Waring et al. (2001)				86.4 (6.1)	88.1 (6.5)		94.9 (4.5)		96.6 (3.3)		98.3 (2.1)	

( ) – Standard Deviation

Summary

This review of previous studies demonstrates that there is an enormous amount of data on the phonological development of English speaking children. The areas of phonological development that have been studied include age of speech sound acquisition, phonological processes and speech sound accuracy, which investigate children's phonological performances from different angles. When the information from these studies is combined, they provide a comprehensive view of children's phonological development as a whole. SLPs have more data on which to base their decisions when such information is combined in their assessment of children in clinics. They do not have to rely on just single types of information when coming to clinical decisions. For future research, all of the aspects of phonological development should be considered together in order to reflect the children's phonological status. However, the methodological limitations described above have to be overcome in future research in order to get findings which are more valid and reliable and which will have greater clinical value.

1.4 Phonological Studies in Dialectal English

As already discussed, there are extensive studies of phonological development of Standard English (SE) speaking children. SE is often referred to when assessing the speech status of English speaking children, including children who speak a dialectal variety of English when specific norms for that variety are not available. It is commonly accepted that the speech forms used by dialectal English speakers have distinctive and predictable characteristics that are different from those used by SE speakers (Bland-Stewart, 2003; Kayser, 1989; Oetting & Garrity, 2006; Perez, 1994; Wilcox & Anderson, 1998; Wolfram, 1994). Therefore, the use of SE norms for dialectal English speakers is definitely inappropriate. The use of inappropriate norms will lead to consequences of either over or under-diagnosis of phonological problems. Cole and Taylor (1990) examined the effect of dialect on 10 African American Vernacular English (AAVE) speaking children aged 5 to 6 years old and found that over half of the children were misdiagnosed with phonological disorders if dialect was not taken into consideration. It is important, therefore, to determine the standards of phonological normalcy in order to carry out phonological assessments of speakers of different varieties of English, so that SLPs will have appropriate norms to use as a reference, and avoid making clinical decisions about children from other dialectal varieties based on norms for children learning SE.

The issues of distinguishing between difference and disorder for individuals who speak dialectal English have been highlighted worldwide (Bland-Stewart, 2003; Kayser, 1989; Oetting & Garrity, 2006; Perez, 1994; Wilcox & Anderson, 1998; Wolfram, 1994). Dialectal variation is known as a mutually intelligible form of language associated with a particular geographical region, social class or ethnicity (Iglesias & Anderson, 1993). A speech difference exists when individuals meet the speech norms of their linguistic community but do not meet the norms of SE. Williams (1972) noted that language variation is a logical and expected phenomenon. Therefore, variations or non-standard versions of a language should not be regarded as deficient versions of that language. Individuals whose speech and language patterns reflect a cultural dialect should not be considered for remediation unless their phonological patterns are outside the cultural norm for the region or the ethnic group. As in ASHA (2003), no dialectal variety of English is a disorder or a pathological form of speech or language. This becomes a challenge for SLPs who must distinguish a true speech disorder from a speech difference in children who speak a dialectal variety of English. Consideration of an individual’s dialect or linguistic background is crucial when assessing phonology in various cultural groups who speak English. Wolfram (1994) reported on the case of AAVE as the phonology of a socio-cultural variety. There are several AAVE phonological characteristics, which converge with the developmental stages of SE, such as cluster reduction and stopping. However, the interpretation that AAVE speakers have a developmental phonological disorder or speak underdeveloped versions of SE phonology is definitely incorrect.

It is necessary to understand how socio-cultural varieties of English are distinguished from each other. Many different varieties of English have been studied, for example, African American Vernacular English (Wilcox & Anderson, 1998; Wolfram, 1994), Australian English (James, 2001), Spanish-influenced English (Goldstein, Fabiano, & Washington, 2005; Goldstein & Iglesias, 2001) and Cantonese-influenced English (Holm & Dodd, 1999). McLeod (2005) compiled more than ten studies on speech acquisition of varieties of English around the world in order to understand normal phonological behaviour for dialectal speakers because this affects assessment and treatment considerations for such speakers.

1.5 Background on Malaysia

Dialectal varieties of English are also widely used in Asian countries such as Malaysia and Singapore as a result of British colonization (Schneider, 2007). Malaysia was first exposed to English in the year 1786 during colonization by the British. English in Malaysia has evolved into a distinct variety of English which differs in many aspects of phonology from SE and incorporates many of the phonological features of local languages such as Malay, Mandarin Chinese and Tamil. In order to study the variation of English in Malaysia, it is important to take note of its unique social and cultural background. Malaysia is a multi-ethnic, multi-cultural and multilingual society. The population in March 2010 was 28.6 million (Department of Statistics, 2010). The population consisted of 65.1% Malays, 26.0% Chinese, 7.7% Indians and other indigenous people such as Portuguese Eurasians and Chinese Babas (Population and Housing Census, 2000). Malay, often called “Bahasa Malaysia” is the national and official language in Malaysia and is widely used by all the ethnicities in Malaysia. English serves as a secondary as well as international language in the country. Nowadays, it is also a first language for many Chinese and Indians in Malaysia. Malays speak Malay as their home language. Chinese use Mandarin Chinese and Chinese dialects such as Hokkien, Cantonese, Teochew and Hakka as their home languages. Indians use Tamil and Indian languages such as Telugu, Urdu, Hindi and Malayalam as their home languages.

1.6 Dialectal Variation: Malaysian English (MalE)

Malaysian English (MalE) is a new variety of English within World Englishes (Kachru, 1985, 1988, 1992; McArthur, 1987). There are several models that provide a description of where MalE fits into World Englishes. According to McArthur's (1987) circle of World English, MalE falls under East Asian Standardizing English among the eight divided regions, and is within the same circle of Other Englishes as Singapore English, Hong Kong English and Philippines English. In Kachru's (1985, 1988, 1992) three-circle model of the spread of English: the Inner, Outer and Expanding circles, Malaysian English belongs to the Outer Circle, because English travelled from Britain in the second dispersion to Malaysia during British colonization from 1824-1944 and 1945-1957. As MalE belongs to the Outer Circle of the three concentric circles, the English spoken in Malaysia is also referred to as "norm-developing." In other words, MalE has gradually become established and is developing its own standards. The definition of the word "standard" is wide-ranging, but in this case, it refers to "conforming in pronunciation, grammar and vocabulary to the usage of the most educated native speakers and widely considered acceptable or correct" (Pakir, 1993; 79). It is vital that SLPs are aware of these changes and the emerging pronunciation as MalE becomes fully established.

The use of English is widespread in Malaysia with approximately 32% of Malaysians using English in daily communication in the country (Bolton, 2008). The MalE variety being described here represents speakers who use English either as a dominant language or who have acquired it from a young age and use it side-by-side with other languages, e.g. Malay, Mandarin or Tamil. MalE is neither a classic creole continuum nor a classic diglossic community (Gupta, 1994). It has been described as polyglossic (Platt & Weber, 1980; Richards & Tay, 1977) and as a 'creoloid' (Platt, 1977). More recently, Nair-Venugopal (2000), Morais (2001) and Schneider (2007) described MalE as a nativized variety, which refers to the features which create a localized linguistic identity of a language variety (Kachru, 1986). MalE and Singapore English (SgE) are very similar as Malaysia and Singapore were a single geo-political identity from 1957-1965. MalE and SgE were usually studied together by scholars (Brown, 1988a, 1988b; Platt, Weber, & Ho, 1983; Tongue, 1979). However, due to the social demarcation over the past 40 years, MalE and SgE are now discussed independently. The label "Malaysian English" signifies a localized variety that is systematically different from BrE at all levels. Although MalE evolved from BrE, it is also substantially influenced by American English (AE) and by the local languages of Malaysia such as Malay, Mandarin Chinese and Tamil. MalE has now developed its own distinctive features that specifically distinguish it from other varieties.

A basic question is whether MalE can be regarded as a uniform variety of English in Malaysia. It seems that, MalE cannot be defined as one uniform variety of English because of the existence of different forms of MalE. Two types of definitions of varieties of MalE have been given. The first definition is used to describe three ethnic sub-varieties or “ethnolects” of MalE. Nair-Venugopal (2000) used ethnolects to refer to the segmental phonology and prosody of the members of the three major ethnic groups: Malay, Chinese and Indian. Similarly, Bautista and Gonzalez (2006) reported that MalE variation depends on the ethnic roots of the speakers: Malay, Chinese and Indian. We can therefore refer to three main types of MalE: Malay-influenced, Chinese-influenced and Indian-influenced. This thesis focuses on Chinese-influenced MalE which is used by Chinese speakers of English in Malaysia.

The second definition of the varieties of MalE is used to identify the lectal range or continuum of MalE (Augustin, 1982; Baskaran, 1994, 2004; Gill, 1999; Morais, 2001; Platt, Weber, & Ho, 1984). Although the terms used by researchers to describe the continuum of MalE are different, there are nevertheless similarities. Baskaran (1994) described MalE using a three-tiered approach: official/standard, unofficial/dialectal and broken/patois. Official MalE shows slight variation from standard BrE and is internationally intelligible. There are more variations in unofficial MalE, including prosodic features (stress and intonation). Broken MalE exhibits severe variation, which are almost unintelligible internationally. Recently, the standard three-tiered creole lectal continuum: acrolect, mesolect and basilect (Bickerton, 1976) has been used to describe MalE (Asmah, 2004). Asmah (2004) indicated that a continuum exists between the varieties of acrolect, mesolect and basilect and MalE speakers may code-switch between them depending on context. The acrolect is regarded as near-native English, and not many Malaysians belong to this category. Those who are found to speak the acrolect variety are usually educated in core English-speaking countries from early schooling up to tertiary education. Thus, only a small percentage of Malaysians are proficient in it. Most academics, professionals and other English-educated Malaysians, speak mesolect English. Mesolect English is used in formal and semi-formal situations. At this level, features that are not found in other forms of English begin to emerge. Basilect English is the colloquial English used in informal settings. Therefore, English used at this level has unique phonological, lexical, and grammatical features which are substantially different from the Standard English. These different forms of MalE should be carefully considered when investigating the features of MalE. For example, Chinese-influenced and Indian-influenced MalE are different in certain ways. /v/ sounds will be pronounced as [w] in Chinese-influenced MalE (Rajadurai, 2007). On the other hand, /w/ sounds will be pronounced as [v] in Indian-influenced MalE (Baskaran, 2004). Therefore, it is inappropriate to regard these forms of MalE as one single identical variety.

The phonology of Chinese-influenced MalE will be strongly influenced by Mandarin Chinese which is usually used in the home environment by Chinese. Zhao (1995) presented a list of vowel and consonant errors which will likely be made by Chinese speakers of English from China. From Zhao's prediction, Chinese adult speakers of English will substitute target sounds in English which are absent from Mandarin Chinese phonology and replace them with near equivalent sounds in Mandarin Chinese. Zhao also discussed the pronunciation of diphthongs in English by Chinese speakers. Chinese speakers tend to reduce the contrast between long and short vowels in English, and diphthongs are like long vowels, thus Chinese-influenced diphthongs too will be short.

The prediction of pronunciation problems with vowels in English are:

- /i/ and /ɪ/ confusion due to absence of /ɪ/ in Mandarin Chinese
- /æ/ and /ɛ/ confusion due to absence of /æ/ in Mandarin Chinese
- /ɑ/ and /ʌ/ confusion due to absence of /ʌ/ in Mandarin Chinese
- /u/ and /ʊ/ confusion due to absence of /ʊ/ in Mandarin Chinese
- /ɜ/ and /ə/ confusion and may be substituted with [ɤ] and [o].

The prediction of pronunciation problems with consonants in English are:

- /p, t, k/ and /b, d, g/ confusion because /p, t, k/ are aspirated in Mandarin Chinese and English, but more intensely in English. Confusion of Mandarin /p, t, k/ with English /b, d, g/ may occur as a result of differences in aspiration.
- /v/ is absent from Mandarin Chinese, therefore, [w] and [f] are substituted for /v/, with [f] substitution in coda position.

- /θ/ and /ð/ are absent from Mandarin Chinese, so [t], [s] and [f] are substituted for /θ/ and [d], [dz] and [v] are substituted for /ð/.
- /z/ is absent from Mandarin Chinese and frequently replaced by the unaspirated voiced affricate [dz], which may be confused with English with /dʒ/ and /tʃ/.
- Dark /ɫ/ in coda position is difficult for Chinese speakers as lateral consonants never occurs in the coda.
- Word-medial /ŋ/ is considered a difficult sound for Chinese speakers.

Although Chinese speakers of MalE will have the strongest influence from Mandarin Chinese, the influence of Malay should not be disregarded for Malaysian Chinese, because Malaysian Chinese who grow up in Malaysia will have substantial influence from Malay. Thus, the pronunciation features of English by Malaysian Chinese might not be totally similar to Chinese from China.

1.7 Studies on Malaysian English Phonology

Research on speech acquisition of MalE speaking children has gained little attention so far. The majority of the studies on MalE have concentrated on adults (Baskaran, 2004; Preshous, 2001; Rajadurai, 2007; Schneider, 2003), with little focus on children. The majority of MalE speaking adult studies are not comprehensive and lack appropriate methodology. The studies either do not analyze a corpus of data or are based on a very small number of participants. For example, Baskaran reported the phonological characteristics of MalE analyzed subjectively; Schneider observed the phonotactic features of MalE as spoken by educated speakers and used in the mass media; Preshous stated the features of MalE in brief when he described MalE origins and development and Rajadurai discussed the phonological features of one Malaysian Chinese male adult in her study of sociolinguistic perspectives on MalE variation. More detailed and careful work on MalE is needed, with analysis based on a corpus of data and a greater number of participants. The study of phonological normalcy for MalE speakers should begin with the adult population as adult models serve as the most appropriate underlying form against which to compare the child's surface productions. Therefore, a description of adult’s phonology is essential prior to further investigation on the relation between the child's phonological system and the adult's system. However, the existing phonological studies of MalE speaking adults do not use quantitative analyses in providing an explicit description of phonological patterns. The types and occurrences of MalE phonological patterns used in the adult population are under-explored. This information is essential so that SLPs will have sufficient knowledge about the phonological features of MalE in order to determine whether or not a MalE speaking individual has a phonological disorder.

The studies of Malaysian English speaking children are very limited compared to adult studies. To date, a small number of published studies have been reported (Joseph, 2007; Lim, Howard, & Wells, 2008). Two forms of MalE have been discussed: Chinese-influenced and Indian-influenced MalE. Lim et al. studied the interaction of MalE consonants with Malay and Mandarin consonants produced by 64 trilingual Chinese Malaysian children aged between 2;06 and 4;06. The findings of this study revealed that consonant production accuracy in MalE improved from age 2;06 to 4;05 and was related to accuracy in Malay and Mandarin languages. Some error patterns in MalE were also found in the other two languages, indicating that universal developmental maturation tendencies were taking place. Lim, et al.'s study is considered as having a relatively small number of participants with a limited age range from the perspectives of normative data, so the representativeness of the data might be a concern. Joseph provided a preliminary description of phonological acquisition of Indian-influenced MalE. Five Malaysian Indian children aged two to six years were recruited. Both speech samples of children and their mothers were recorded and analyzed because the mothers' speech represented the children's most active environmental linguistic input. The consonantal phonemic inventory and phonological processes were described. There was a significant correspondence between the mothers' and the children's phonemic inventory. However this study compared the phonemic inventory of the children with regard to the adult form rather than attempting to establish normative data. More studies about MalE are needed, especially ones that describe the normal development of Malaysian children with a larger number of participants from a wider age range.

1.8 Bilingual Phonology in Malaysian Children

Due to the complexity of the socio-cultural and linguistic background of Malaysia, Malaysian children are usually bilingual or multilingual regardless of their ethnic group. They are often able to switch from one language to another with ease. The scenario of multilingualism in Malaysia is similar to Singapore, where multilingualism is almost universal and where code-mixing is prevalent (Gupta, Brebner, & Yeo, 1998). In the Malaysian context, bilingualism constitutes a continuum and individuals may have varying degrees of skills or abilities in the two or more languages involved. There are almost no child monolinguals after preschool age. Apart from the mother tongue used in the home environment since birth, the nature of the society and the large amount of English and Malay input that the children receive within the school system account for the rapid acquisition of these languages upon entering preschool. Children who receive home language exposure in the home environment and learn other languages at preschool are categorized as early bilinguals (Genesee, Paradis & Crago, 2004, cited in Fabiano-Smith & Goldstein, 2010). Therefore, these Malaysian children belong to the category of early bilinguals.

Classical studies of bilingualism usually focus on two languages. For example, in the study of bilingual children's phonology, most of the researchers describe the phonological development of bilingual children using two languages, such as Spanish-English (Fabiano-Smith & Goldstein, 2010; Goldstein & Washington, 2001), Farsi-English (Keshavarz & Ingram, 2002), Cantonese-English (Holm & Dodd, 1999), Mandarin-English (Lee, Zhu, & Ballard, 2010; Lin & Johnson, 2010), Swedish-Arabic (Salameh, Nettelbladt, & Norlin, 2003) and Spanish-German (Lleó, 2006). Bilingual children's phonological performances are also commonly compared with monolingual children, for instance, Spanish-English bilinguals were compared with monolingual Spanish and English speakers (Goldstein, et al., 2005). Nevertheless, if we look at the number of languages used by Malaysian Chinese children, it is much more complicated. There are almost no homogenous bilinguals in Malaysia. Apparently, multilingual Malaysian children acquire an average of two to three languages. Therefore, a comparison of bilingual Malaysian children with monolingual children is not likely to be helpful. A consideration of all the common languages used by multilingual Malaysian children is essential in accounting for their phonological acquisition. The use of mixtures of two or more languages on a daily basis by multilingual children in the Malaysian context will lead to interference in the phonological systems of all these languages. For example, in Lim et al.'s (2008) study of consonant acquisition of trilingual Malaysian children who speak Chinese, Malay and English, interference patterns or language transfer were deemed to be a possible reason to account for the differences of phonological patterns observed in these three languages.

1.9 Languages-In-Contact

When there is contact between two languages, a tendency exists for each to influence the other. The influence of one language on the other in bilingualism studies is known as interference patterns (Haugen, 1956; Paradis & Genesee, 1996; Weinreich, 1953). Weinreich (1953) described four types of interference patterns: under-differentiation of phonemes, over-differentiation of phonemes, reinterpretation of distinctions and phone substitution. *Under-differentiation of phonemes* occurs when two sounds of the secondary system are not differentiated due to the influence of the primary system. For instance, Spanish speakers of English might be fail to distinguish /d/ and /ð/ in English as [d] and [ð] are variants of /d/ in Spanish, but serve as two different phonemes in English. *Over-differentiation of phonemes* happens when a phonemic distinction from the primary system is imposed on the secondary system. For example, Chinese speakers of English might interpret allophones [p^h] and [p] in English as two different phonemes as /p^h/ and /p/ are separate phonemes in Mandarin. *Reinterpretation of distinctions* takes place when the phonemes of the secondary system are differentiated based on features that are relevant but redundant in the primary system. For example, a German speaker of English will regard the primary difference between *beet* and *bit* as length rather than vowel quality (tense/lax) as German has distinctive vowel length as in *bieten* (offer) and *bitten* (ask). *Phone or sound substitution* occurs when phonemes in two languages are defined identically but differ in pronunciation. For instance, English speakers of Spanish might use [ɹ] for /r/ in Spanish. Haugen (1956) used different terms to describe interference; however the descriptions are similar to those used by Weinreich (1953). For example, *simple identification* is similar to *phone or sound substitution*, *divergent* substitutes for *under-differentiation of phonemes* and *convergent* replaces *over-differentiation of phonemes*.

Paradis and Genesee (1996) regarded the interference patterns as “interdependence” and identified three possible types of interdependence: transfer, acceleration and delay. *Transfer* would occur when the features of the dominant language present in the other language. Transfer might occur in a bi-directional manner that is from one language to the other and vice versa. For instance, *transfer* occurred in Spanish-English bilingual children when phonetic characteristics of Spanish were demonstrated in English, indicating language interaction between Spanish and English (Fabiano-Smith & Goldstein, 2010). *Acceleration* would result if features that are acquired earlier in one language might be acquired earlier than expected in the other language. The basis for this is that the interaction between the two languages facilitates the acquisition process and results in superior linguistic skills in bilinguals. For example, the acquisition of coda consonants in Spanish productions was accelerated in German-Spanish speakers compared to monolingual Spanish-speaking peers due to the acquisition of German (Kehoe, Trujillo, & Lleo, 2001). *Delay* or *deceleration* would happen when children demonstrate slower development in one or both of their languages relative to monolingual children. The principle of this claim is that interaction between the two languages interferes with the acquisition process and causes poorer linguistics skills in bilinguals compared with monolinguals. For instance, bilingual English-Spanish children showed slower rates of acquisition compared to their monolingual peers based on measures of accuracy (Gildersleeve-Neumann, Kester, Davis, & Pena, 2008). Fabiano-Smith & Goldstein (2010) suggested an additional term “a variation to acceleration” to Paradis and Genesee’s (1996) “interdependence” hypothesis. This term is used to account for bilingual children who exhibit rates of acquisition that fall within the normal range for monolingual speakers of both languages such as in the studies reported by DeHouwer (1995), Goldstein et al. (2005) and Goldstein & Washington (2001). The premise behind this hypothesis is that one language might be assisting in the acquisition of the other, permitting a rate of acquisition in bilinguals that falls within the normal range as monolingual children for the same age.

In the case of Malaysian children who are multilingual, it is expected that the interference patterns of languages will be more complicated compared to studies of bilinguals due to the involvement of more than two languages. For instance, a Malaysian Chinese child who speaks English and is exposed to Mandarin Chinese and Malay at the same time will exhibit interference patterns resulting from all three languages.

1.10 Phonology of English, Mandarin Chinese and Malay

Knowledge of phonological properties of the common languages used by Malaysian children will help in understanding the phonological acquisition of these languages in terms of language interference. English and Malay are compulsory languages that are taught in the Malaysian school system. Therefore, Malaysians will eventually be competent in these two languages after entering preschool regardless of their ethnicity.

As this study considers only Malaysian Chinese children, the languages commonly used by these children are Mandarin Chinese, English and Malay. Chinese dialects such as Hokkien, Cantonese and Teochew are occasionally used by these children at home. As there are many different types of Chinese dialects being used, it is difficult to illustrate them in detail. However, Chinese dialects share a lot of similar phonological properties with Mandarin Chinese. One of the major differences is the extensive use of glottal stops in the dialects which is absent from Mandarin Chinese.

Most researchers agree on the description of the phonological system of English (Gimson, 1989; Wells & Colson, 1971), although some follow a particular theoretical orientation (e.g. Chomsky & Halle (1968) described the sound system using distinctive features). There are 21 consonants (b, p, d, t, ɡ, k, v, f, θ, ð, z, s, ʒ, ʃ, m, n, l, r, dʒ, tʃ, ŋ, h) and two glides (j, w) in English. There are 12 vowels in English (ɪ, e, æ, ʌ, ɒ, ʊ, ə, i, ɑ, ɔ, u, ɜ), which have been classified by tongue height, tongue position and lip rounding. English also has eight diphthongs (eɪ, aɪ, ɔɪ, oʊ, aʊ, ɪə, eə, ʊə), which are sequences of two vowel sounds together in the same syllable.

As for Mandarin Chinese, there is no mutual agreement on the classification of consonants and vowels among researchers. Chen (1999) and Hua (2000) reported that there are 21 consonants (p, p^h, t, t^h, k, k^h, f, s, ʂ, ts, ts^h, tʂ, $tʂ^h$, tɕ, $tɕ^h$, ɕ, ŋ, n, l, r, m) with the exclusion of glides (j, w, ɥ). On the other hand, Cheng (1973), Chin (2006) and Duanmu (2000) proposed that there are 22 consonants, adding in the velar fricative /x/.

There is also controversy in the analysis of vowels in Mandarin Chinese among researchers which can be seen in Table 1.11. It has been proposed that there are no vowels (Pulleyblank, 1984), two vowels (Wang, 1993), five vowels (Duanmu, 2000; Chin; 2006), nine vowels (Hua, 2000) and 10 vowels (Cheng, 1973). The lack of agreement on vowel analysis has resulted in variation of analysis in diphthongs and triphthongs. Duanmu (2000) and Chin (2006) denoted (/ae, ei, ow, ao/) as diphthongs. Hua (2000) divided diphthongs into offglides: ae, ei ,ow, ao and onglides: (iA, iɛ, uA, uo, yɛ). Offglide vowels have the first vowel element longer and more intense while for onglides, the second elements are more sonorous. Cheng (1973) claimed that there are eight diphthongs. Duanmu (2000) posited that there is no triphthong in Mandarin Chinese by claiming that many analyses of triphthongs include a diphthong and a prenuclear glide. If the prenuclear glide is in the onset, there will be no triphthongs in Mandarin Chinese. However, Hua (2000) and Cheng (1973) regarded these combinations as triphthongs in their analyses, resulting in 4 triphthongs (iɑo, iow, uae, uei) and 5 triphthongs (iɑi,uɑi, uɤi, iɑu, iɤu) in their respective studies.

Table 1.11: The Vowel Systems in Mandarin Chinese

Authors	Pulleyblank (1984)	Wang (1993)	Duanmu (2000) & Chin (2006)	Hua (2000)	Cheng (1973)
Monophthongs	None	2 vowels ə, A	5 vowels i, u, a, y, ə excluding the retroflex vowel	9 vowels i, u, A, y, ə, o, ɛ, ɤ including the retroflex vowel	10 vowels i, u, a, y, ə, o, ɛ, e, ɑ, a
Diphthongs	None	NA	4 diphthongs ae, ei ,ow,ao	9 diphthongs ae, ei ,ow,ao iA, iɛ, uA, uo, yɛ	8 diphthongs iɑ, uɑ, iɤ, uɤ, yɤ, ɑi, au, ɤu
Triphthongs	None	NA	None	4 triphthongs iɑo, iow, uae, uei	5 triphthongs iɑi,uɑi, uɤi, iɑu, iɤu

Due to the controversial views about the consonant and vowel systems in Mandarin, Hua (2000) is taken as the reference in this thesis as Hua used this system in her study of phonological acquisition of Modern Standard Mandarin Chinese speaking children, which is particularly relevant to the present thesis. However, it is worth-noting that varieties of Mandarin spoken in Malaysia might have a character of their own and their phonemic inventories may differ compared to Standard Mandarin Chinese. Although the varieties of Mandarin Chinese spoken in Malaysia are under-explored, Mandarin Chinese spoken in Malaysia might be similar to that in Singapore and is most likely to have a Xiamen (Hokkien) dialect basis. This seems to be borne out by the fact that glottal stops, which are characteristic features of Hokkien but not of Cantonese or Standard Mandarin, are used readily in syllable-final position in consonants (Norman, 1988). In addition to that, many Chinese Singaporeans used an additional rù tone or a fifth tone which is characterized with a falling pitch contour, shorter duration and increased tenseness of the whole syllable (Chen, 1999). Bearing this in mind, the variety of Mandarin Chinese spoken in Malaysia may well be somewhat different from the standard. However, since no analysis of Malaysian Mandarin has been carried out, Standard Mandarin Chinese is used as a benchmark in this thesis.

As for Malay phonology, there are 19 consonants (b, p, d, t, g, k, s, h, m, n, ŋ, ɲ, l, r, dʒ, tʃ,ʔ) and 2 glides (j, w), 6 monophthongs (i, e, a, u, o, ə) and 3 diphthongs (ai, au, ua) (Awang Sariyan, 2004; Hashim and Lodge, 1988; cited by Lodge, 2009).

As a background to considering the multilingual phonological acquisition of Malaysian Chinese children, the phonemic system of English (Gimson, 1989; Wells & Colson, 1971), Mandarin Chinese (Hua, 2002) and Malay (Awang Sariyan, 2004; Hashim and Lodge, 1988; cited by Lodge, 2009) are compared as displayed in Table 1.12. The sound systems of these three languages are classified according to place of articulation, manner and voicing for comparison. The comparison of vowels is shown in Figure 1.1.

The similarity in terms of shared and unshared sounds of English with Mandarin Chinese and Malay is indicated in Table 1.13 for consonants in SI and Table 1.14 for vowels. The concept of 'phonetic similarity' which was originally used in second language phonological acquisition (Flege, 1981, 1987) has recently been adapted and generalized into the study of the phonology of bilingual children (Fabiano-Smith & Goldstein, 2010; Goldstein, Fabiano, & Iglesias, 2003). Flege (1981) found that second language adult learners experience difficulty in perceptually categorizing second language sounds which are phonetically similar to those in their first language. Speech sounds in the second language are perceived based on the first language phonemic categories. This causes the generalization of familiar sounds in the first language into new second language phonetic contexts. Fabiano-Smith & Goldstein (2010) and Goldstein et al. (2003) found that sound categorization as proposed by Flege (1981) could happen in the phonology of bilinguals in a similar way to second language learners. They hypothesized that bilingual children perceive two similar sounds in their two languages as identical and classify them into the same phonemic category. In addition to that, they suggested that the shared (phonetically similar) sounds in two languages are more quickly accessed and thus extend into the phonetic contexts of both languages. More production experience with the shared sounds will lead to higher accuracy in the production of these sounds compared to unshared (phonetically dissimilar) sounds and cause increased rate of acquisition.

A similar framework of phonetic similarity is proposed by Döpke (2000). Döpke (2000) applied a languages-in-contact proposal to phonological development. When languages come into contact, they exhibit mutual influences. When there are structural similarities in the two languages, knowledge of the basic sounds in one language will be transferred to the other language. For example, nasals /m, n, ŋ/ occur in English and Mandarin Chinese. These nasal sounds are likely to be transferred to the second language of English-Chinese bilingual speakers. When the differences between two phonemes are subtle, changes may occur at the phoneme level. For example, the lack of long and short vowels in Mandarin Chinese might have a negative effect on English vowels. /u/ and /ʊ/ in English are distinguished by quality and length. However, these vowels are close enough in production characteristics that English-Chinese bilingual speakers might regard them as the same vowel.

The knowledge of phonetic similarity among shared and unshared sounds in English (Gimson, 1989; Wells & Colson, 1971), Mandarin Chinese (Hua, 2002) and Malay (Hashim and Lodge, 1988; cited by Lodge, 2009) is essential in understanding the phonological acquisition of multilingual Malaysian children. Phonemically, English shared 18 consonants with either Mandarin Chinese or Malay, with six consonants (v, z, ð, θ, ʃ, ʒ) distinct to English. It is worth noting that some of these consonants which are distinct to English also appear in the Malay language. This is because Malay has borrowed some of the Arabic consonants (f, v, θ, ð, z, ʃ, x, ɣ) into Malay. However, these imported consonants are not used by all Malay speakers and they are often substituted by the nearest equivalent from the native Malay system (Hashim and Lodge, 1988; cited by Lodge, 2009). In the present thesis, only the native Malay phonological system is considered.

Table 1.12: The Phonemic Contrasts of English, Mandarin Chinese and Malay Consonants

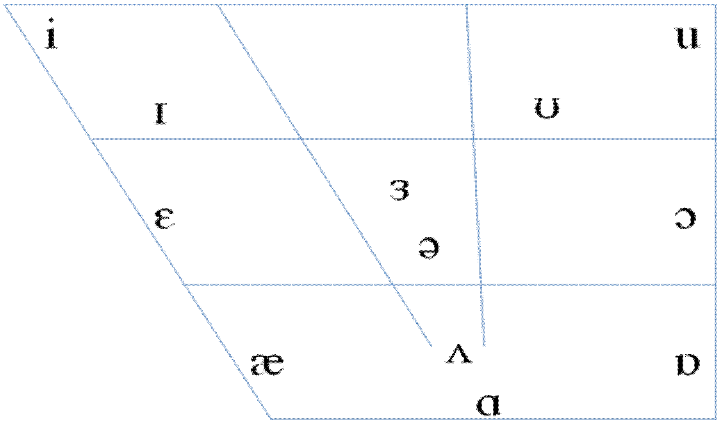
Place		Bilabial		Labio-Dental		Lingua-Dental		Alveolar		Retro-Palatal		Palatal		Velar		Glottal
Manner	**Language**	V	VL	V	VL	V	VL	V	VL	V	VL	V	VL	V	VL	VL
Stops	E	b	p					d	t					g	k	
	MC		p p^h						t t^h						k k^h	
	M	b	p					d	t					g	k	ʔ
Fricatives	E			v	f	ð	θ	z	s			ʒ	ʃ			h
	MC				f				s	ʂ			ɕ			x
	M								s							h
Affricates	E											dʒ	tʃ			
	MC								ts ts^h		tʂ tʂ^h		tɕ tɕ^h			
	M											dʒ	tʃ			
Nasals	E	m						n						ŋ		
	MC	m						n						ŋ		
	M	m						n				ɲ		ŋ		
Laterals	E							l								
	MC							l								
	M							l								
Rhotics	E							r								
	MC									r						
	M							r								
Glides	E	w										j				
	MC															
	M	w										j				

V - Voiced
VL - Voiceless

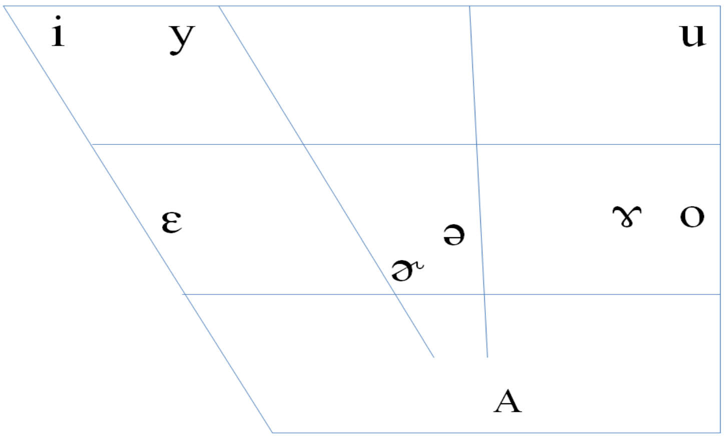
E - English
MC - Mandarin Chinese
M - Malay

Note:
The phonemic symbols here are the ones commonly used for transcribing each language.

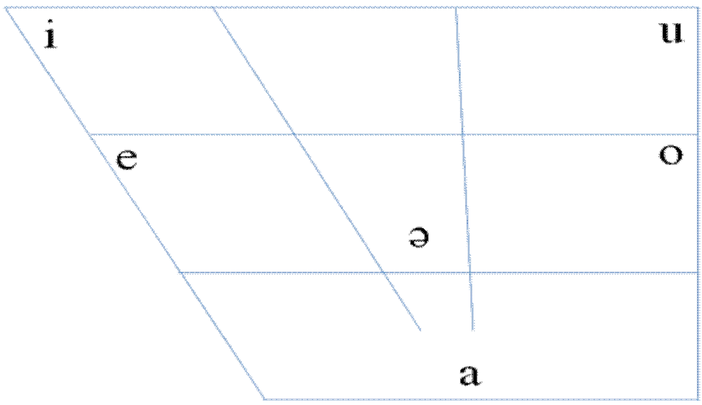
Figure 1.1: The Phonemic Contrasts of English, Mandarin Chinese and Malay Vowels



Standard British English vowel qualities on a cardinal diagram (Wells & Colson, 1971)



Mandarin Chinese vowel qualities on a cardinal diagram (Hua, 2002)



Malay vowel qualities on a cardinal diagram (Hashim & Lodge, 1988)

Table 1.13: Shared and Unshared Consonants in English, Mandarin Chinese and Malay in Syllable Initial Position

Sound Classes	Shared consonants with MC	Shared consonants with M	Shared consonants with either MC or M	Unshared consonants specific to E	Unshared consonants specific to MC	Unshared consonants specific to M
Stops	p, t, k p^h, t^h, k^h	p, t, k	p^h, t^h, k^h, **p, t, k**			ʔ
Fricatives	f, s	s, h	f, **s,** h	v, z, ʃ, ð, θ, ʒ	ʂ, ɕ, x	x
Affricates		dʒ, tʃ	dʒ, tʃ		ts, ts^h, tʂ, $tʂ^h$, tɕ, $tɕ^h$	
Nasals	m, n	m, n, ŋ	**m, n,** ŋ			ɲ
Laterals	l	l	**l**			
Rhotics	r	r	**r**			
Glides	w, j	w, j	**w, j**			
Total Number	14	14	18	6	9	3

E - English MC - Mandarin Chinese M - Malay

Notes:

- The phonemic symbols here are the ones commonly used for transcribing each language.
- Consonants in **bold** occur both in Mandarin Chinese and Malay

Table 1.14: Shared and Unshared Vowels in English, Mandarin Chinese and Malay

Sound classes	Shared vowels with MC	Shared vowels with M	Shared vowels with either MC or M	Unshared vowels specific to E	Unshared vowels specific to MC	Unshared vowels specific to M
Close	i, u	i, u	**i, u**	ɪ, ʊ	y	o
Close mid	ə	ə	**ə**	ɜ	ɤ, o	
Open mid	ɛ		ɛ	ʌ		e
Open	a	a	**a**	æ, ɒ		
Total Number	5	4	5	6	3	2

E - English MC - Mandarin Chinese M - Malay

Notes:

- The phonemic symbols here are the ones commonly used for transcribing each language.
- Vowels in **bold** occur both in Mandarin Chinese and Malay

There are also some sounds in these three languages which are different in phonetic realization. The details of the phonetic realization of stops (e.g. /b/ and /p/) in these languages is shown in Table 1.15. The phonetic realization of voiced stops /b/ in English is similar to unvoiced stops /p/ in Mandarin Chinese and Malay. The /b/ sound in Malay is pre-voiced. The phonetic realization of /l/ in English and Mandarin Chinese is relatively dark [ɫ] but it is produced as clear [l] in Malay. The phonetic realizations of /r/ in English, Mandarin Chinese and Malay are respectively produced as approximant [ɹ], retroflex [ɻ] and trill [r]. As for vowels, English shares five vowels with Mandarin Chinese and Malay. These shared vowels are mostly long vowels. The number of unshared vowels which are specific to English is slightly more than the number of shared vowels in Mandarin Chinese and Malay. Those unshared vowels are predominantly short vowels. In fact, Mandarin Chinese and Malay regard all vowels as neutral in length as there is no distinction of vowel length in either language.

Table 1.15: Phonetic Features of Stops in English, Mandarin Chinese and Malay

Languages	Voice, No aspiration	Unvoiced, No aspiration	Unvoiced, Aspiration
English	na	/b/ [p]	/p/ [p^h]
Mandarin Chinese	na	/p/ [p]	/p^h/ [p^h]
Malay	/b/ [b]	/p/ [p]	na

Based on the phonetic similarity hypothesis, it is presumed that MalE speaking children will acquire shared sounds between English, Mandarin Chinese and Malay earlier or at least at a comparable rate as native English speakers due to the increased production experience in these languages. Shared sounds that were present in both Mandarin Chinese and Malay will have a greater reinforcement impact towards the acquisition of MalE compared to sounds shared only in one language due to more opportunities for production. For example, /p, t, k, s, m, n, l, r, w, j/ in SI and /s, n, ŋ/ in SF. As for unshared sounds, Malaysian English speaking children might acquire these sounds later than shared sounds. For instance, the consonants /ð/, /θ/, /ʒ/ and most likely /v/, /z/, /ʃ/ will be acquired later compared to other consonants. However, in the application of the phonetic similarity hypothesis, factors such as phonetic environment, phonotactic structures and syllable position should not be disregarded. Flege (1995) claimed that positive transfer of consonants is bounded by source and target segments that have the same position in the syllable. Therefore, the presumption of shared and unshared sound acquisition between English, Mandarin Chinese and Malay will be applicable only when all these factors are controlled. For instance, /dʒ/ and /tʃ/ are shared between English and Malay in SI, but do not occur in SF in Malay. Therefore, the acquisition of /dʒ/ and /tʃ/ in SF might not be similar to SI. It is worthwhile to compare the phonetic similarity in terms of shared and unshared sounds of English with Mandarin Chinese and Malay in syllable final position. The comparison is indicated in Table 1.16.

Table 1.16: Shared and Unshared Consonants in English, Mandarin Chinese and Malay in Syllable Final Position

Sound classes	Shared consonants with MC	Shared consonants with M	Shared consonants with either MC and M	Unshared consonants specific to E	Unshared consonants specific to MC	Unshared consonants specific to M
Stops				b, p, d, t, g, k		ʔ
Fricatives		s	s	f, v, θ, ð, z, ʒ, ʃ,		h
Affricates				dʒ, tʃ		
Nasals	n, ŋ	m, n, ŋ	m, **n, ŋ**			
Laterals		l	l			
Rhotics						r
Total Number	2	5	5	15	0	3

E - English MC - Mandarin Chinese M - Malay

Notes:

- The phonemic symbols here are the ones commonly used for transcribing each language.
- Consonants in **bold** occur both in Mandarin Chinese and Malay

The number of unshared consonants in English is three times as great as the number of shared consonants with Mandarin Chinese and Malay in SF. This demonstrates that the number of shared consonants in SF is small. Less production opportunity with the shared sounds is thus granted and this may cause slower rates of SF consonant acquisition in English, especially for stops, fricatives (except /s/) and affricates. Shared sounds that were present in both Mandarin Chinese and Malay, such as /s, n, ŋ/ will have greater impact in MalE compared to sounds shared only in one language due to more opportunities for production.

Apart from the consideration of syllable position, it is also important to understand the similarities and differences of other aspects such as syllable structures and stress patterns of English, Mandarin Chinese and Malay phonology as these factors will influence the phonological acquisition in term of phonetic similarities. Lin and Johnson (2010) reported that phonological patterns such as final consonant deletion, final consonant devoicing and syllable reduction are more evident in bilingual Mandarin-English children which might be attributed to the different linguistic systems of the bilinguals' two languages, such as differences in morphological complexity and phonotactic structures. As can been seen from the Table 1.17, the number of consonants in English, Mandarin Chinese and Malay does not differ much. The most prominent differences between English, Mandarin Chinese and Malay are the number of consonants used in SI and SF. English has comparable number of consonants in SI and SF. Mandarin Chinese has 24 consonants in SI, but only two consonants in SF. Malay has more syllable final consonants than Mandarin Chinese, but still less than English. Both Mandarin Chinese and Malay have fewer syllable final consonants than English. It is presumed that the speakers of Mandarin Chinese and Malay will find realization of consonants in SF difficult.

The vowel system of Mandarin Chinese and Malay is relatively simpler than English. Both languages do not make a distinction between vowel lengths, either phonemically or allophonically. Vowel length is one of the important features that must be maintained in English in order to preserve intelligibility (Jenkins, 2001). Therefore, it might be expected that considerable variation will be seen in Malaysian English in terms of vowel length.

Table 1.17: Phonology Differences between English, Mandarin Chinese and Malay

	English	Mandarin Chinese	Malay
Syllable-initial consonants	24 consonants (inclusive of glides) b, p, d, t, g, k, v, f, ð, θ, z, s, ʒ, ʃ, h, m, n, ŋ, l, r, dʒ, tʃ 2 glides (j, w)	24 consonants (inclusive of glides) p, p^h, t, t^h, k, k^h, f, s, ʂ, ɕ, x, ts, ts^h, tʂ, $tʂ^h$, tɕ, $tɕ^h$, m, n, l, r 3 glides (j, w, ɥ)	19 consonants (inclusive of glides) b, p, d, t, g, k, s, h, m, n, ŋ, ɲ, l, r, dʒ, tʃ,ʔ 2 glides (j, w)
Syllable-final consonants	20 consonants b, p, d, t, g, k, v, f, ð, θ, z, s, ʒ, ʃ, m, n, ŋ, l, dʒ, tʃ	2 consonants n, ŋ	8 consonants ʔ, s, h, m, n, ŋ, l, r
Vowels	12 monophthongs ɪ, e, æ, ʌ, ɒ, ʊ, ə, i, ɑ, ɔ, u, ɜ 8 diphthongs eɪ, aɪ, ɔɪ, əʊ, aʊ, ɪə, eə, ʊə	9 monophthongs i, u, y, o, ɤ, ᴀ, ə, ɚ, ɛ 9 diphthongs ae, ei ,ow,ao, iᴀ, iɛ, uᴀ, uo, yɛ 4 triphthongs iɑo, iow, uae, uei	6 monophthongs i, e, a, u, o, ə 3 diphthongs ai, au, ua
Clusters	*Initial consonant clusters* 41 with CCV- structures (b, p, d, t, g, k, θ + l, r, j) (s + p, t, k, l, w) 10 with CCCV- structures (s + p, t, k + l, r, j, w) *Final consonant clusters* 59 with –VCC structures 49 with –VCCC structures	None	None (apart from loan words from English)
Syllable structures	$[C_{0\text{-}3}]$ - V - $[C_{0\text{-}4}]$	$[C_{0\text{-}1}]$ - V - $[C_{0\text{-}1}]$	$[C_{0\text{-}1}]$ - V - $[C_{0\text{-}1}]$
Tones	None	4 tones (high level, rising, low level and falling)	None
Stress at word level	3 levels stress: Primary, secondary and unstressed	Equal stress, weak stress is an essential prosodic feature	Word stress in Malay is a controversial area[1]

[1] There is no consistent description of stress at word level in Malay. Kahler (1965) claimed that the stress falls on the penult when the root word is next to an enclitic such as *-kah*, *-lah* or *-pun*. Alisjahbana (1967) found that word stress is fixed on the final syllable, unless it is a clitic pronoun -ku or -nya. Amran (1984) revealed that word stress falls on the penult in isolated words, but on the final syllable in context. Zuraidah, Knowles and Yong (2008) found that there is no stress in Malay.

Table 1.18 displays the shared consonants in English, Mandarin Chinese or Malay in SI and SF. It shows that only five consonants in SF were shared in English, Mandarin Chinese and Malay.

Table 1.18: Shared Consonants in English, Mandarin Chinese or Malay

Consonants in English	Syllable-Initial	Syllable-Final
b, p, d, t, g, k	p^h, t^h, k^h, **p, t, k**	na
v, f, s, z, ð, θ, ʒ, ʃ, h	f, **s,** h	**s**
dʒ, tʃ	dʒ, tʃ	na
m, n, ŋ	**m, n,** ŋ	m, **n, ŋ**
l	**l**	l
r	**r**	na
w, j	**w, j**	na
Total	**18**	5

Consonants in **bold** occur both in Mandarin Chinese and Malay

Both Mandarin Chinese and Malay have very simple syllable structures. There are four types of syllables in the Malay language: V, VC, CV and CVC (Gomez & Reason, 2002). Mandarin Chinese has mostly open syllables, with only two nasal consonants (/n/ and /ŋ/) appearing in SF. Neither language contains consonant clusters in the initial or final syllable, though Mandarin Chinese can have a glide /j/ after the initial consonant. Speakers of these two languages might find consonant clusters difficult. Mandarin is the only tonal language among the languages. The stress patterns of the three languages are very different. English has far more complicated stress patterns than the other two. Malay usually stresses the final syllable of a word and Mandarin Chinese has equal stress at word level, though weak stress is an essential prosodic feature. Therefore, the speakers of Malay and Mandarin Chinese will find the stress patterns of English complicated, and thus have difficulty in learning them. However, a study of the stress patterns of MalE is largely beyond the scope of the present thesis apart from consideration of vowels in unstressed syllables.

All these differences mean that multilingual Malaysian children who are learning English, Mandarin Chinese and Malay at the same time might have different expected patterns of phonological acquisition than monolingual children learning one of these languages. For instance, the acquisition of English by Malaysian children will be different from monolingual English speaking children.

1.11 The Use of Phonological Assessments in Malaysia

The use of culturally and dialectally sensitive assessment tools is a major topic worldwide in the profession of speech-language pathology including Malaysia. SLPs spend approximately 20% of their working time in evaluation, indicating that evaluation is a major regimen for the profession (Lingwall, 1988). Malaysian SLPs encounter challenges in the process of evaluating and diagnosing their clients due to a critical shortage of culturally appropriate and sensitive assessment tools in Malaysia (Lian & Abdullah, 2001). A challenge with assessment instruments is an issue that Malaysian SLPs need to deal with in delivering services to their multilingual clients (Low, 2006).

The use of inappropriate assessment tools may produce biased and inaccurate conclusions. Different types of test bias have been discussed by researchers. Adler (1993) proposed two types of bias: deliberate bias and non-deliberate bias. Taylor and Payne (1983) and Vaughn-Cooke (1986) addressed four basic forms of bias: situational bias, directions or format bias, value bias and linguistic bias. Grossman (1995) and Wyatt (1995) elaborated on content and gender bias. Definitions of different types of bias are given in Table 1.19. Among these test biases, content bias and linguistic bias continue to be problems that researchers highlight in the assessment process, especially when assessing individuals from diverse cultural backgrounds. For example, it is likely that linguistic bias will occur if Malaysian children, whose phonological patterns of English do not match the "standard version" of English, are perceived to have a delay or disorder because they differ when tested with phonological tests standardized for General American English (GAE). Content bias tends to occur when standardized norm-referenced measures developed overseas, which reflect the life experience and socialization practices of their local children, are performed on Malaysian children. For example, the standardized phonological assessment developed by Goldman and Fristoe (2000) in the United States, contains vocabulary such as *wagon*, *shovel,* and *bathtub* which are unfamiliar to children in Malaysia. A few items in the Bankson-Bernthal Test of Phonology (Bankson & Bernthal, 1990) such as *wagon*, *seal*, *sled*, *kangaroo*, *yard*, and *tub* are similarly culturally inappropriate for Malaysian children.

Table 1.19: Different Types of Bias in Assessments

Adler (1993)	Deliberate bias	Inclusion of test items that are unrepresentative of the individual's language, learning style, behavioural set, community or culture
	Non-deliberate bias	Administering tests which are normed on mainstream society to non-mainstream individuals, resulting in negative interpretations.
Taylor and Payne (1983)	Situational bias	Mismatches between clients' and clinicians' social rules of learning, behavioural and language interaction.
	Directions / format bias	Individuals not being familiar with the assessment procedures or when directions do not consider different behavioural cognitive and learning styles.
	Value bias	Individuals being expected to show knowledge or acceptance of values that may be unfamiliar to them or make judgements about what a person should do in a given situation, which is unfamiliar or unacceptable to them.
	Linguistic bias	Associated with the discrepancy of the use of standardized tests referring to i) the language or dialect used by the examiner; ii) the language or dialect used by the child; iii) the language or dialect that is expected in the child's responses.
Grossman (1995) and Wyatt (1995)	Content bias	All children being assumed to have similar exposure to certain concepts or vocabulary.
	Gender bias	Each gender is likely to respond correctly to test items which they are more familiar with and/or more interested in.

Culturally sensitive and linguistically appropriate articulation and phonological assessment tools are important to identify clients with speech impairment effectively and accurately. To do this, a number of scholars have amended the scoring procedures of standardized articulation tests to recognize vernacular dialect phonologies, so that these speakers are not penalized simply for being dialectally different (e.g., the Goldman-Fristoe (2000) and Fisher-Logemann (1971) tests). Researchers in Singapore have been developing more appropriate norms for the acquisition of Singapore English. Gupta et al. (1998) adapted the PRO-ED Speech & Language Developmental Chart (Gard, Gilman, & Garman, 1993), incorporating findings from research on Singapore

English acquisition and the perceptions of experienced SLPs. To date, there has been little formal research designed to develop culturally and linguistically appropriate assessment tools for English-speaking Malaysian children, although an unnormed Bahasa Malaysia Word List is regularly used for Malay-speaking children (personal communication, Fatimah Hani Hassan, Universiti Kebangsaan Malaysia, 2008). However, some preliminary research has been initiated towards the study of phonological development of local English-speaking children. Joseph (2007) considered phonological acquisition in Malaysian English child speakers of Indian descent and Lim et al. (2008) looked briefly at consonant acquisition in trilingual Malaysian Chinese children. In December 2006, the National University of Malaysia and the National University of Singapore organized a conference "Language Assessment and Intervention Tools for Malaysia and Singapore" which created a platform for professionals such as SLPs, linguists and educators in Malaysia and Singapore to discuss the development of local assessment tools for their multilingual populations.

1.12 Summary and Thesis Aims

Articulation and phonological impairments are frequent in the child population, affecting up to 15% of preschoolers and 6% of elementary school children in the USA (ASHA, 1995). According to a recent report, the prevalence of communication disorders in Australia, inclusive of difficulties with articulation, was between 12.40% and 13.04% (Mcleod & McKinnon, 2007). The prevalence of phonological disorder in Malaysia remains unknown. However, referring to the average prevalence worldwide, the prevalence of phonological disorder is expected to be similarly high in Malaysia. Therefore, clients with speech impairments are likely to be a common occurrence in Malaysian SLPs' caseloads. In spite of this, there is limited documented data which are not sufficient to describe the phonological patterns of both MalE speaking adults and children. Thus, it is difficult to distinguish a speech difference from a speech disorder. Many SLPs in Malaysia may not completely understand the phonological patterns of MalE, and this may lead to difficulty with accurate diagnosis for these speakers. Undoubtedly, MalE speakers have distinctive and predictable characteristics that are different from those of so-called SE, but these variations will reflect differences not delays or deficiencies. Therefore, it is important to discover how SLPs in Malaysia assess their speech impaired clients given the absence of culturally appropriate assessment tools. A first step towards exploring the area of phonological assessment for Malaysian English speaking children is needed.

The **first aim** of this thesis is to survey a wide sample of Malaysian SLPs in order:

1. To determine the types of articulation and phonological assessment currently used by Malaysian SLPs.
2. To investigate the adequacy and accuracy of current articulation and phonological assessment in meeting clinical needs.
3. To describe the experiences of SLPs in using current articulation and phonological assessments.
4. To explore the need for further research in the areas of articulation and phonology.

Subsequent to this, it is also important to gather information about the characteristics of the consonant and vowel realizations of adult MalE speakers. The MalE phonological patterns exhibited by adult speakers will be regarded as a normal variation or dialectal phonology of MalE. This information is important because SLPs will then have data to rely on when distinguishing a language difference that is due to MalE variation from a language disorder.

The **second aim** of this thesis therefore is to provide an explicit description of MalE phonology by using a quantitative auditory phonetic analysis. The specific goals are:

1. To investigate the consonant and vowel inventories of MalE.
2. To investigate the characteristics of the consonant and vowel realizations of MalE in terms of types and occurrence.
3. To investigate the possible influences and interference patterns within MalE.
4. To compare the phonological patterns of MalE with major phonological processes exhibited by SE speaking children in order to distinguish dialectal phonological processes from developmental phonological processes.

Due to the absence of local normative data in phonology for Malaysian children, Malaysian SLPs are asking for reliable and valid normative data for MalE speaking children. This normative data are necessary in order to identify MalE speaking children with phonological impairments. Materials from the first and second aims will provide the background information for the major section of the thesis.

To date, little is known about the phonological development of MalE English speaking children. The **third aim** and also the **major aim** of this thesis are to provide valid and reliable normative data for the phonological development of MalE in Malaysian Chinese children between the ages of 3 and 7 years. Under this aim, the following specific objectives are addressed with respect to Malaysian Chinese children who are learning MalE from an early age:

A) Age of Speech Sound Acquisition

1. To determine the age of customary production and mastery production of
   i) different MalE consonants in syllable initial (SI) and final (SF) positions;
   ii) MalE vowels;
   iii) MalE consonant clusters in SI and SF.
2. To compare the age of speech sound acquisition in MalE with Standard English (SE).

B) Speech Sound Accuracy

1. To determine the speech production accuracy in terms of Percentage of Consonants Correct (PCC), Percentage of Vowels Correct (PVC) and Percentage of Consonant Clusters Correct (PCCC) at different ages when assessed with and without taking MalE dialectal features into consideration.
2. To investigate whether there are significant differences between PCC, PVC and PCCC at different ages when assessed with and without taking MalE dialectal features into consideration.
3. To examine any sex and age effect in terms of PCC, PVC and PCCC.
4. To compare the speech sound accuracy in MalE with SE.
5. To determine the accuracy of consonants according to i) different sound classes, ii) syllable positions and iii) phonetic similarities at different ages.
6. To determine the accuracy of vowels according to syllable type.
7. To determine the accuracy of consonant clusters according to i) syllable positions, ii) cluster categories and iii) number of cluster constituents.

C) Phonological Processes

1. To examine the types and occurrence of dialectal and developmental phonological processes exhibited by MalE speaking children.
2. To examine any significant differences in sex and age effects on the occurrence of phonological processes.
3. To determine the age of suppression for developmental phonological processes.
4. To compare the age of suppression for developmental phonological processes in MalE with Standard English (SE).

The outline of the present thesis is:

Chapter 1: Literature review

Chapter 2: Surveying the perception of Malaysian SLPs in articulation and phonological assessments (First aims)

Chapter 3: Investigating the phonological features of Malaysian English in adult speakers (Second aims)

Chapter 4: Methodology for the normative study of children's phonological development

Chapter 5: Age of speech sound acquisition (Third aims part i)

Chapter 6: Speech sound accuracy (Third aims part ii)

Chapter 7: Phonological processes (Third aims part ii)

Chapter 8: General discussion

CHAPTER 2
SURVEYING THE PERCEPTION OF MALAYSIAN SPEECH-LANGUAGE PATHOLOGISTS IN ARTICULATION AND PHONOLOGICAL ASSESSMENTS

2.0 INTRODUCTION

The lack of culturally appropriate and sensitive assessment tools for assessing Malaysian children with speech and language disorders has been highlighted (Lian & Abdullah, 2001; Low, 2006). To compensate for the lack of appropriate assessment tools, most of the Malaysian SLPs use informal assessment procedures to identify the children's general communicative competence rather than specific linguistic skills (van Dort, 2005). In a situation where linguistics skills are not properly assessed, it will lead to consequences of either over or under-diagnosis. Given the absence of culturally appropriate assessment tools in Malaysia, it will be worthwhile to investigate the perception of Malaysian SLPs about articulation and phonology assessments which involve linguistic components. The **first aim** of this thesis is to survey a wide sample of Malaysian SLPs in order to:

1. Determine the types of articulation and phonological assessment currently used by Malaysian SLPs
2. Investigate the adequacy and accuracy of current articulation and phonological assessment in meeting clinical needs
3. Describe the experiences of SLPs in using current articulation and phonological assessments
4. Explore the need for further research in the areas of articulation and phonology.

2.1 METHODOLOGY

2.1.1 Design

Survey research was used in this study for collecting information about the SLPs' perception of articulation and phonological assessment in Malaysia. The survey was uploaded online at www.monkeysurvey.com (Finley, 1999). A list of SLPs in Malaysia was obtained via member directories of the Malaysian Association of Speech-Language and Hearing (MASH, 2007) and the Malaysia Health Ministry. A total of 85 question-naires were sent out via electronic mail together with a letter describing the purpose of the study. Approximately two weeks after the initial mailing, a follow-up letter soliciting participation, restating the importance of the research and expressing a strong appeal for participation was sent to all the potential participants. Within 5 weeks, 38 questionnaires were completed by Malaysian SLPs. Overall returns represented a 45% response rate of the people contacted. Based on the last count in March 2007 (as reported in the Allied Health Professionals Act Planning Meeting), there were 115 SLPs in Malaysia inclusive of senior SLPs who are no longer practising. As a whole, the responses rate truly reflected at least 33% of the SLP population in Malaysia.

2.1.2 The Survey Instrument

The survey (Appendix A) consisted of a four-page questionnaire which was divided into two sections. The first section sought details about the demographic information of the participants such as gender, ethnicity, setting of practice, qualifications, and years of practice. The second section encompassed questions investigating the perception of articulation and phonological assessment in Malaysia. This section consisted of both open and closed questions. Closed questions included yes/no questions and multiple-choice questions. Multiple-choice questions were used to let participants choose from a list of preselected answers. Due to the limitation of closed questions, open questions were used to look for answers, which were impossible to predict in advance. A bracketed option designated as ( ) other with the word “please specify” was regularly included to allow an opportunity for participants to provide their individual opinions. In addition to that, a Likert scale which asked participants to express their order of preference for the options was made available. Returned questionnaires were organized and data were analyzed quantitatively and qualitatively.

2.2 RESULTS

2.2.1 Demographic Characteristics of the Respondents

The characteristics of the respondents regarding gender, ethnicity, qualification, setting of practice and years of practice are shown in Table 2.1. The vast majority of respondents (92.1%) were female. The distribution of respondents by ethnicity was 42.1% Chinese, 36.8% Malay, 15.8% Indian, and 2.6% Eurasian and other, respectively. The majority of the respondents (86.8%) held a bachelor degree. The rest of the respondents held a master degree. The number of respondents reduced as the years of practice increased. A majority of the respondents had 0 to 2 years of practice (36.8%) and 3 to 5 years of practice (34.2%). A minority of respondents (10.5%) had more than 10 years of practice. Half of the respondents practised in a government hospital. The rest of the respondents were distributed in other settings. Most of the respondents (84.2%) were actively dealing with clients with impaired phonology or articulation.

Table 2.1: Characteristics of Respondents and their Demographic Background

Characteristics		Respondents		Respondents who had seen clients recently	
		N	%	N	%
Gender	Female	35	92.1	31	81.6
	Male	3	7.9	2	5.3
Ethnicity	Chinese	16	42.1	16	42.1
	Malay	14	36.8	12	31.6
	Indian	6	15.8	5	13.2
	Eurasian	1	2.6	1	2.6
	Other	1	2.6	1	2.6
Qualification	Bachelor degree	33	86.8	29	76.3
	Master degree	5	13.2	4	10.5
Years of Practice	0-2	14	36.8	12	31.6
	3-5	13	34.2	11	28.9
	6-8	7	18.4	6	15.8
	9-10	0	0	0	0
	>10	4	10.5	3	7.9
Setting of Practice	Government hospital	19	50.0	18	47.4
	Private hospital	3	7.9	3	7.9
	Private clinic	4	10.5	4	10.5
	University clinic	3	7.9	0	0
	University (research)	2	5.3	1	2.6
	Non-Government Organization	2	5.3	2	5.3
	Special school	4	10.5	4	10.5
	Combination	1	2.6	1	2.6

2.2.2 Types of Articulation and Phonological Assessment Used

The respondents' articulation and phonological assessment usage fell into two patterns. Respondents used either: (1) both standardized tests and informal tests (13.2%) or (2) only informal tests (86.8%). As shown in Table 2.2, the types of standardized articulation and phonological tests used by five of the respondents were the Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 2000), the South Tyneside Assessment of Phonology (Armstrong & Ainley, 1988), and the Phonological Profile for Hearing Impaired Test (Vardi, 1991). Informal articulation or phonological assessments were widely used by all of the respondents to assess their clients. The most popularly used informal test was picture naming, which was employed by 30 respondents. The least frequently used informal test was reciting numbers, letters, and rhymes (15).

Table 2.2: Types of articulation and phonological assessments used by Malaysian SLPs

Assessments	Respondent N	Respondent %	Types of Assessment	Respondent (N)
Formal	5	13.2	Goldman-Fristoe Test of Articulation	2
			South Tyneside Assessment of Phonology	2
			Phonological Profile for Hearing Impaired Test	1
Informal	38	100.0	Picture naming	30
			Conversation	27
			Self-developed and customized single word test	25
			Story telling	21
			Reading	18
			Reciting numbers, alphabets and rhymes	15

2.2.3 The Adequacy of Current Articulation and Phonological Assessments

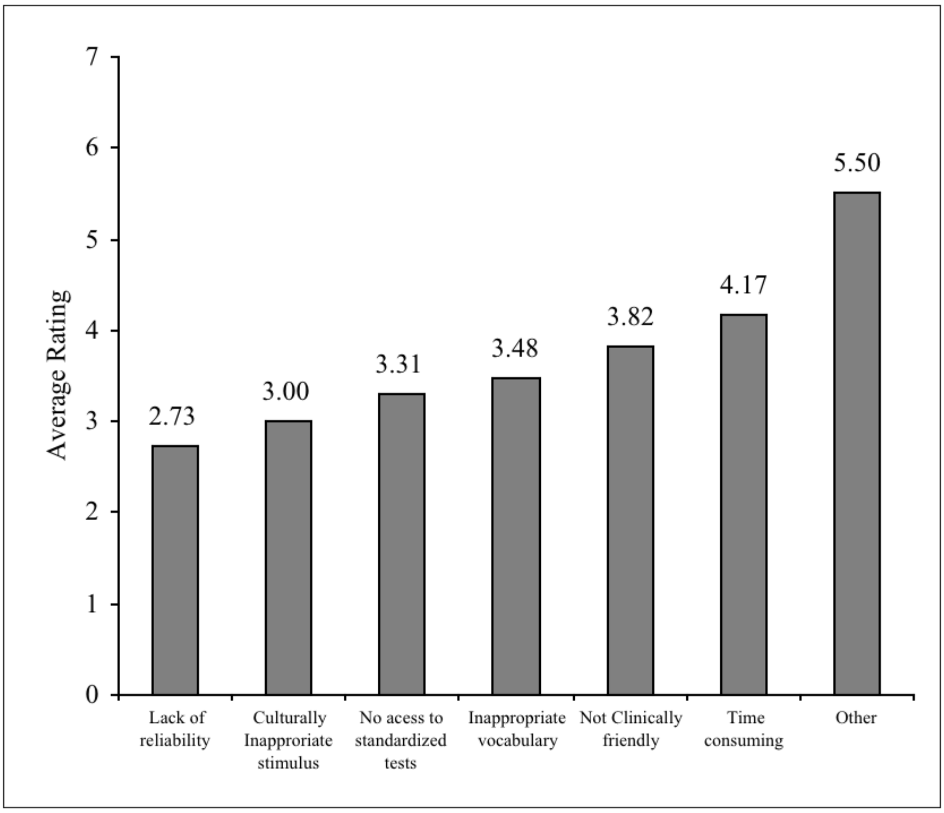
The respondents' perception of the adequacy of the current articulation and phonological assessments was investigated. Two-thirds of the respondents (25 people, 66%) agreed that the lack of locally developed standardized tests and the utilization of informal assessments of articulation and phonology in their clinics were not adequate for eliciting accurate diagnosis or for planning intervention. SLPs were asked about the impact of the lack of culturally and linguistically appropriate assessments and the use of informal assessments. Their main concerns were:

1. The lack of appropriate norms for Malaysian children
2. SLPs diagnosing clients based on their instincts
3. Sole reliance on informal assessments causing invalid and unreliable results
4. The variety in the style of testing and differences in the stimuli used in informal assessments
5. The lack of consistency in interpretation of results because of variations in the clinician's clinical experience and judgement

2.2.4 The Experiences of Using Articulation and Phonological Assessments

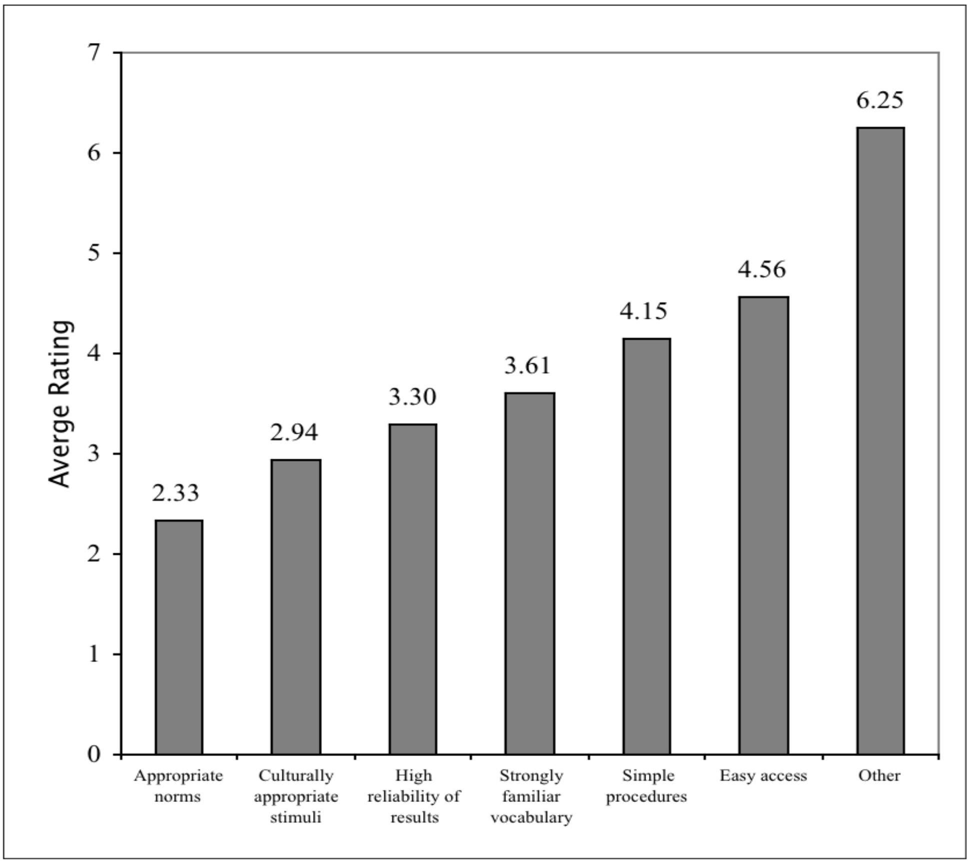
The majority of the respondents showed dissatisfaction with the currently used articulation and phonological assessments, both standardized and informal. The respondents who did not use standardized tests ordered their reasons for not using them (Figure 2.1, where lower rating values indicate greater importance). The most important reason given was the lack of reliability of the standardized tests. This was then followed by culturally inappropriate stimuli, lack of access to standardized tests and inappropriate vocabulary in the tests. Suggestions that the standardized tests were not clinically friendly or too time consuming were ranked as less important.

Figure 2.1. Order of Preference of the Reasons Provided by Malaysian SLPs for not Using Standardized Tests of Articulation and Phonology. These results were averaged across the ratings for all respondents and lower rating values indicated greater importance.



The order of preference of the important aspects of the standardized tests was also ranked by the respondents (Figure 2.2 where lower rating values indicate greater importance). The respondents ranked the need for appropriate norms as the first priority. Simple procedures and easy access remained less important. It was clear that reliability of results and appropriate norms in the standardized tests were major concerns of the respondents. In addition to that, culturally relevant stimuli and vocabulary also were strongly highlighted.

Figure 2.2. Order of Preference Noted by Malaysian SLPs of the Important Aspects of Standardized Tests of Articulation and Phonology. These results were averaged across the ratings for all respondents and lower rating values indicated greater importance.



2.2.5 The Need for Developing English Phonology Assessments

Due to the lack of normative data and of appropriate assessment tools for Malaysia, 89.5% of the respondents concurred that there was a need for collecting phonological developmental data and creating English articulation and phonology assessments for Malaysian children. The benefits of creating these assessment tools were seen as: (1) The ability to describe normal speech development for Malaysian children; (2) The ability to recognize sociocultural factors (e.g., ethnicity, language background); (3) The ability to provide culturally appropriate stimuli (pictures and words) and (4) The ability to consider cross-linguistic effects that affect the speech development.

2.3 DISCUSSION

In the present study, Malaysian SLPs demonstrated their concerns about the lack of appropriate assessment tools for multicultural populations. This problem is not encountered only in the Malaysian population, but has also been reported worldwide. For example, similar circumstances are reported for countries like Singapore (Gupta, Brebner, & Yeo, 1998) and for the minority Hispanic group in the United States (Goldstein & Cintrón, 2001; Goldstein & Washington, 2001; Goldstein, 2001; Goldstein & Iglesias, 1996a, 1996b, 2001; Levey & Cruz, 2004; Mann & Hodson, 1994). Obviously, the scarcity of culturally appropriate standardized articulation and phonological tests in Malaysia leads to difficulty in clinical management of speech impaired clients. Standardized articulation and phonological tests traditionally are an important tool to describe the phonological status and determine the normalcy of speech development, determine the treatment direction, make predictive and prognostic statements, monitor phonological performance change across time, and identify factors of phonological deficits (Bankson & Bernthal, 1996). The lack of local assessment tools appeared to prevent Malaysian SLPs from accurately describing the phonological status of their clients, and thus limited their ability to determine whether their clients' speech sound systems were sufficiently different from normal development to warrant intervention.

Generally, the lack of developmental phonological data could lead to undesirable consequences such as (1) a delay or absence of diagnostic and intervention services, (2) incorrect diagnosis of normal or phonologically disordered children, and (3) a misdiagnosis of a phonological disorder by using data collected from other populations (Yavas & Goldstein, 1998). This happens because test norms are applicable to clients who most reflect the test's standardized sample population, rather than clients who are least like the test's standardized sample population. Thus, performing a Standard English language test on a client from a nonstandard dialect of English will lead to unreliable results (Damico, 1991; Kayser, 1989; Lund & Duchan, 1993; Taylor & Payne, 1983). MalE phonology is different from the English phonology of native English speakers (Baskaran, 2004). Therefore, the need to investigate the dialectal English used in Malaysia is crucial. No dialectal variety of English is a disorder or a pathologic form of speech or language (ASHA, 1983) and the consideration of variable or dialectal English is paramount in the assessment of children from culturally and linguistically diverse groups. Therefore, it is essential to collect developmental data for English-speaking children in Malaysia.

All the conditions mentioned above have been and will continue to be problems that SLPs in Malaysia will face in the assessment of articulation and phonology. Therefore, constructive initiatives should be taken to overcome these problems. Examples of such initiatives are given in the next section.

2.4 CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

This study provides insight as to Malaysian SLPs' perspectives on the current use of articulation and phonology assessments in the country. The findings of this survey provide useful information for SLPs, both clinically and research based, who work with children and adolescents affected by articulation and phonology impairments. In addition, the findings will also be useful to policy makers such as committee members of the Malaysian Association of Speech-Language and Hearing (MASH), who are seeking to improve conditions for clinical practice especially in the area of articulation and phonology assessments and management. Finally, the findings of this study provide valuable information for countries with multicultural and multilingual populations such as Singapore, the Philippines, and Indonesia in their development of speech language therapy services especially in the field of articulation and phonology.

Considering that it is difficult to produce local standardized tests in a short period of time, SLPs in Malaysia should consider working toward short-term solutions that are feasible. Provisionally, SLPs in Malaysia should consider using standardized tests developed overseas but systemizing the modification procedures for using them. Several ideas for using standardized tests developed overseas in more meaningful ways for culturally diverse population have been suggested (Terrell, Battle, & Grantham, 1998; Wolfram, 1983). Some feasible suggestions include: (1) changing the scoring to permit dialect alternatives to be considered correct. SLPs should examine the possible dialectal effect on the stimulus items in a test before administering the test. They should prepare a list of these dialectal responses for each test. For example, if the correct test response for an item is final cluster /sk/, SLPs should predetermine that a normal English-speaking Malaysian response to that item is final cluster reduction to /s/ which should be scored as correct. SLPs who score tests with the dialectal variation as normal responses should indicate what responses were regarded as correct; (2) establishing local normative data for a standardized test developed overseas by determining the mean scores and standard deviations for the Malaysian population. The test will then be more representative for the local population; and (3) replacing biased stimuli with a parallel form with more culturally appropriate items. For instance, the stimulus *sled* in the Bankson-Bernthal Test of Phonology (Bankson & Bernthal, 1990) could be replaced with a more familiar item such as *slide*. The target responses of initial /s/ and final /d/ are still retained. Therefore, it is essential that Malaysian SLPs work together to identify suitable pictures to be included in a test which would still retain the target responses.

Malaysian SLPs indicated alternative assessment strategies were their main choice since dialect-sensitive and culturally fair standardized assessments are not available. A wide variety of informal assessments is employed by Malaysian SLPs; thus, it would be wise to set guidelines for informal assessments in term of the administrative procedures and analysis. This would help to prevent problems such as inconsistency of evaluation processes, tedious testing experiences and non comprehensive test results. Among the informal assessments used, connected speech samples are a universally well-known procedure (Bankson & Bernthal, 1990; Morrison & Shriberg, 1992; Shriberg & Kwiatkowski, 1980; Stoel-Gammon & Dunn, 1985). Suggestions for obtaining conversational samples for informal clinical evaluations include: (1) comparing client-family member and client-clinician conversations; (2) using culturally relevant or familiar objects to elicit conversation such as activities (e.g., *Hari Raya Aidilfitri* for Malay, *Chinese New Year* for Chinese and *Deepavali* for Indian), food (*nasi lemak*, prawn noodles, *rojak*) and clothing (*baju kurung*, *tudung*, sari); and (3) carrying out a parent-child comparative analysis using the cultural and linguistic patterns of the parent who is the primary language model as the referent criteria.

Working toward the future, the only certain way to help eliminate the difficulties encountered by Malaysian SLPs is to develop an assessment instrument and local normative data that are specifically designed for the Malaysian population. Although the development of a local standardized test and local normative data is time and cost consuming, the benefits will outweigh the costs in the long run. It is believed that the development of local standardized assessment tools and normative data should cover aspects of multilingualism and culturally appropriate stimuli and, more importantly, provide valid and reliable results which truly reflect the performances of Malaysian communities.

CHAPTER 3
INVESTIGATING THE PHONOLOGICAL FEATURES OF MALAYSIAN ENGLISH IN ADULT SPEAKERS

3.0 INTRODUCTION

Information about the phonological features of MalE is needed in order to understand the normal phonological behaviour of MalE speakers as a basis for assessment and treatment considerations for MalE speakers. The investigation of MalE phonological features should always start with the adult population as adults serve as the model of their community and their speech behaviours will be referred to as the norms of the community. This study was designed as a necessary preliminary step to the study of MalE speaking children's phonological development which is the major part in this thesis. The aim of this preliminary study is to provide an explicit description of MalE phonology by using a quantitative auditory phonetic analysis. The specific goals are to:

1. Investigate the consonant and vowel inventories of MalE
2. Investigate the characteristics of the consonant and vowel realizations of MalE
3. Investigate the possible influences and interference patterns within MalE
4. Compare the phonological patterns of MalE with major phonological processes exhibited by SE speaking children in order to distinguish the dialectal variation from developmental phonological processes

3.1 METHODOLOGY

3.1.1 Selection of Participants

Participant selection was designed to limit the variables of age, ethnicity, socio-economic class, gender, education and occupation, all of which affect a person's accent (Wells, 1982). These variables were controlled by selecting Malaysian participants of Chinese descent who were dominant speakers of English. Undergraduates from Malaysia who were studying at the University of Canterbury, New Zealand were selected in order to systematize educational background and occupation. Online questionnaires, which were uploaded on www.monkeysurvey.com (Finley, 1999) and which investigated the participants' educational and language background, were distributed electronically to potential participants via the Canterbury Malaysian

Students' Association. Participants who met the inclusion criteria of using English as the dominant language at home, were invited to participate. The demographics of the participants are shown in Table 3.1. Ten participants were recruited, with equal numbers of females and males. The participants were aged from 19 to 26 years old, with a mean of 21 years old. Their years of residence in Malaysia ranged from 12 to 19.5 years with a mean of 16.15 years. Their years of residence in New Zealand varied from 9 months to 10 years, with an average of 4.54 years. Students who were studying in New Zealand were chosen because the author was studying in that country. It was not initially intended to recruit participants who had been living in New Zealand for longer periods. However, recruitment depended on the availability and willingness of the participants. Therefore, all the participants who met the criteria for the purpose of this study were recruited regardless of years of residence in New Zealand. It could be asked whether students who had lived in New Zealand for longer periods of time might have changed their speech somewhat. This seems unlikely as Asian international students in New Zealand, inclusive of Malaysian students, usually live, study and interacts with their own group, and spend little time interacting with local students. They therefore tend not to acquire features of New Zealand English. In addition, all participants were recruited through the Malaysian Students' Association and took regular part in the Association's activities. The two participants who had lived in New Zealand longest were not noticeably different from the others in terms of their pronunciation.

Table 3.1: Demographics of Participants

Participants	Age	Years of Residence	
		Malaysia	New Zealand
F1	21	16	5
F2	19	12	7
F3	21	17	4
F4	22	19.5	2.5
F5	19	18	0.9
M1	21	18	3
M2	19	15	4
M3	19	15	4
M4	26	13	10
M5	23	18	5
Mean	21.0	16.2	4.5
Standard Deviation	2.3	2.4	2.5

The language background of the participants is shown in Table 3.2. All of them were exposed to English since birth and exposed to other languages such as Mandarin Chinese, Chinese dialects and Malay simultaneously or sequentially. Participants' language proficiency and amount of language usage were self-assessed by the participants. They claimed to have at least the same or better English proficiency as compared to Mandarin Chinese, Malay and Chinese dialects. The average self-rating of their proficiency level of English is "very good". They estimated that they used English 75% of the time in their daily life routines, which indicated that English was their dominant language.

Table 3.2: Language Background of Participants

Participants	Chinese Dialect Used	Age of exposure (Years)				Language Proficiency (Rating)				Amount of Usage (%)			
		E	MC	M	D	E	MC	M	D	E	MC	M	D
F1	Ho	birth	15	6	7	5	2	4	4	100	0	0	0
F2	na	birth	18	6	na	7	2	2	na	100	0	0	0
F3	FC	birth	5	7	8	7	6	5	4	80	20	0	0
F4	Ca	birth	6	7	5	5	5	4	4	80	20	0	0
F5	Ho	birth	0	4	0	5	5	5	4	80	20	0	0
M1	Ca	birth	7	7	4	4	4	4	3	60	40	0	0
M2	Ho	birth	5	5	5	6	2	5	4	60	0	20	20
M3	Ho	birth	5	7	5	6	4	6	5	60	0	20	20
M4	Ho	birth	0	5	0	7	2	1	4	100	0	0	0
M5	Ha,Ca	birth	0	5	0	7	6	6	7	40	20	20	20
Mean		birth	6.1	5.9	3.8	5.9	3.8	4.2	4.3	76.0	12.0	6.0	6.0
SD		birth	6.1	1.1	3.1	1.1	1.7	1.6	1.1	20.7	14.0	9.7	9.7

Language
E - English
MC - Mandarin Chinese
M - Malay
D - Chinese Dialect

Chinese Dialects
Ho - Hokkien
FC - Fu Chow
Ca - Cantonese
Ha - Hakka
na - Not available

Rating of Proficiency Level
1 - very poor
2 - poor
3 - fair
4 - functional
5 - good
6 - very good
7 - native-like

Note: Participants' language proficiency and amount of language usage were self-assessed by the participants.

3.1.2 Materials

A list of 206 items, with 204 single words and two two-word nouns (Appendix B), was designed in order to obtain a large and well-controlled sample for the study. The word list used here was substantially similar to the word list used in the children's study (Chapter 4), apart from 11 words which were later omitted or replaced as children found them unfamiliar or difficult to recognize.[2] The use of a similar word list for adults and children will avoid the issue of differences in terms of word choice and thus reduce variation in the results. A detailed description of word list's development is given in Chapter 4. Speech elicited by reading a word list is relatively formal (Labov, 1994). Many researchers use data from casual speech rather than read material or word lists in order to obtain more natural data (Gregersen & Pedersen, 1991; Labov, 1972; Trudgill, 1974). Other researchers use word lists and read material in order to facilitate exact comparisons between the pronunciations of different speakers in the samples (Di-Paolo & Faber, 1990; Gordon & Maclagan, 2001; Habick, 1980). Milroy (1987, pp. 172-182) discusses the pros and cons of read material versus casual speech, indicating that there are problems with both types of data. In the present study, a word list was used to control the sample and to ensure comparability across speakers. It will sample the more formal end of the speakers' normal pronunciation.

---

[2] A pilot study was carried out on 14 normally developing children in the age range of 2 years 10 months to 3 years 11 months to check the familiarity of the vocabulary in the stimuli prior to the full scale PhD study. Participants below 4 years old were chosen because they were the youngest participants in the full scale PhD study. If younger children could respond to the stimulus pictures, there should not be any problems for older children. A word was deemed to be difficult or unfamiliar if less than 50% of the children could name it spontaneously. 14 difficult words were omitted from the list of 206 words. They were *fence*, *ill*, *vacuum cleaner*, *nail, cook, student, school*, *off, policeman, teddy bear, alligator*, *grandmother*, *cooking* and *fishing.* Two pairs of words, *cook-cooking* and *fish-fishing* were initially included to check on the morphophonemic alternation. It was decided that two pairs were not sufficient to examine this morphophonemic alternation. Therefore, *cooking* and *fishing* were omitted from the test. Three new words were added. There were *police car, crocodile* and *basket. Police car* and *crocodile* were included to replace *policeman* and *alligator* respectively. *Basket* was included to sample 2 syllable words. The final version of the stimuli consisted of 195 words which were used in the children's study.

3.1.3 Equipment

Both audio and video recorders were used to record the participants' speech sample in order to facilitate interjudge reliability checking. A good quality external microphone (Shure SM58) was placed 6 to 12 inches from participants' mouths to record their speech. Their speech was recorded on the recording system in a laptop (Dell Inspiron 640m) in wav format using a Rane amplifier.

3.1.4 Recording Environment and Procedures

Each participant was seen individually at the postgraduate students' research room in the Department of Communication Disorders. The researcher established rapport with the participant prior to recording. The recording was administered in a quiet, well-lit room that contained a table and a chair. Participants were asked to read the list of words, repeating each word three times. The duration of the sessions ranged from 15 to 20 minutes.

3.2 MEASUREMENT AND ANALYSIS

Auditory analysis was employed in the present study. All the speech data gained were transcribed phonetically using earphones and analyzed descriptively. All three tokens of each targeted word were analyzed, so that 6180 tokens were recorded and analyzed. The speech was initially transcribed according to a broad phonetic transcription by the author. A narrow phonetic transcription was used when phoneme production was judged to differ from normal tolerances. In order to establish inter-judge reliability, the speech was then independently analyzed by an experience phonetician and any disagreements were resolved. The inter-judges' agreement ranged from 91.5% to 95.0% for the individual speakers. The first judge is a native speaker of Mandarin and of Malaysian English and is competent in the Malay language; the second judge is a trained phonetician who is a native speaker of English and is familiar with both British and American English.

3.3 RESULTS

In this section the characteristics of the participants' consonants and vowels are discussed with special emphasis on places where they differ from the original input language, British English (BrE). Other varieties of English such as American English (AmE) will be referred to when relevant to highlight their similarities to or differences from MalE. Mohanan (1992) emphasized that the phonology of each language variety should be described as an independent unit on its own terms without referring to an external variety because of a concern that certain features in the new variety will be overlooked if it is always compared with an existing variety. However, it is appropriate to compare MalE with other varieties of English spoken in the region, to attempt to establish the degree to which the English spoken in the territory is unique (Deterding, 2008; Kirkpatrick, 2007). All consonant and vowel realizations were considered as productive consonant realizations of MalE in this study because MalE is still developing into a mature variety with its own standard, which has yet to become fully established. This may result in an extra element of instability. In order to avoid overlooking some of MalE features in the data, all instances of production will be considered. All the examples shown in the results section focus on the particular consonant or vowel realizations being discussed, without taking into consideration all possible MalE realizations of the surrounding phonemes.

3.3.1 Consonant Inventory

A summary of the consonant inventory of MalE as found in the present study is provided in Table 3.3. There are 24 consonants in MalE. Although the consonant inventory for MalE does not differ from that for other varieties of English, many of the consonants were realized in different ways. All consonants except /θ/ and /ð/ were used by all ten participants. Because not all speakers used /θ/ and /ð/, this raises potential questions about their status as phonemes of MalE.

Table 3.3 Consonant Inventory of MalE

Place / Manner	Bilabial	Labio-Dental	Inter-Dental	Alveolar	Post-Alveolar	Palatal	Velar	Glottal
Plosive	p b			t d			k g	
Affricate					tʃ dʒ			
Fricative		f v	*θ ð	s z	ʃ ʒ			h
Nasal	m			n			ŋ	
Liquid				l r				
Glide	w					j		

* The status of /θ/ and /ð/ is debatable.

3.3.2 Phonological Features of Consonants

Although the consonant inventory of MalE was akin to other varieties of English, many of the consonants were realized in different ways. The percentage of occurrence of the consonant features of MalE was analyzed according to the syllable positions of consonants in words as well as the number of speakers exhibiting these features. The results are displayed in Table 3.4. There was a total of 15 major phonological features observed for MalE consonants. The phonological features are presented from most to least frequent.

1. Final consonant devoicing

The affricate /dʒ/ in syllable final position (SF) was devoiced with shortened preceding vowels 80.0% of the time by all the participants. Devoiced fricatives /v/ and /z/ in SF were produced 50.0% of the time by seven and five participants respectively.

Examples:

bridge	[brɪtʃ]	orange	[ɒrɪntʃ]
five	[fɑ͡ɪf]	glove	[gləf]
nose	[nos]	eyes	[ɑ͡ɪs]

2. Dental fricative avoidance

/ð/ as well as cluster /θ/ and singleton /θ/ in syllable initial position (SI) were realized as stops /d/ and /t/ respectively, whereas /θ/ in SF were produced as /f/. The occurrence of dental fricative avoidance ranged from 47.8% to 66.7% across different syllable positions. Half or more speakers used dental fricative avoidance. The term ‘avoidance’ (Baskaran, 2004) is used rather than ‘substitution’ because different substitutions are used for /ð/ and /θ/ in different syllable positions. The fact that different substitutions are used in different positions, indicates that /θ/and /ð/ have not just been absorbed into other phonemes.

Examples:

there	[dɛə]	mother	[mʌdə]
thank you	[tæŋ kju]	nothing	[nʌtɪŋ]
mouth	[maʊf]	birthday	[bɜfdeɪ]
three	[tri]		

Table 3.4: Phonological Features of Consonants in MalE

No	Consonant Realizations		Syllable Position (No. of Tokens)		No. of Occurrences	Occurrence (%)	No. of Speakers
			SI	SF			
1	Final consonant devoicing	/dʒ/→ [tʃ]		120	96	80.0	10
		/v/ → [f]		150	75	50.0	7
		/z/ → [s]		60	30	50.0	5
2	Dental fricative avoidance	/ð/→ [d]	180		120	66.7	7
		/θ/→ [t]	120		70	58.3	8
		/θ/→ [f]		90	43	47.8	5
		Cluster /θ/→ [t]	30		17	56.7	6
3	Glottalization	/b/→ [ʔ]		60	40	66.7	8
		/d/→ [ʔ]		210	100	47.6	8
		/g/→ [ʔ]		150	78	52.0	6
		/p/→ [ʔ]		90	41	45.6	8
		/t/→ [ʔ]		270	126	46.7	10
		/k/→ [ʔ]		330	134	40.6	8
		Total		1110	519	46.8	10
4	Vocalization	Cluster /l/→ [ʊ]		210	126	60.0	9
		/l/→ [ʊ]		180	68	37.8	7
		Syllabic/l/→[ʊ]		90	50	55.7	9
5	Substitution of /v/ with [w]	/v/→ [w]	120		40	33.3	5
6	Omission of /l/	/l/→[ø]		60	21	35.0	4
		Syllabic/l/→[ø]		210	46	21.9	3
7	Rhoticity	Singleton		990	212	21.4	7
		Cluster		180	62	34.4	9
8	Medial Consonant Devoicing	/ʒ/→[ʃ]	60		16	26.7	4
9	Consonant Cluster Reduction	-		570	118	20.7	9
10	Deaspiration of voiceless stops	/p/→ [p]	150		37	24.7	3
		/t/ → [t]	145		28	19.3	3
		/k/→ [k]	200		36	18.0	3
		Total	495		101	20.4	3
11	Use of syllabic /l/	-		210	38	18.1	5
12	/tr/, /dr/ and /str/ affrication	/dr/→[dʒɹ]	60		12	20.0	2
		/tr/→[tʃɹ]	60		6	10.0	2
		/str/→[ʃtɹ]	60		9	15.0	2
		Total	180		24	13.3	4
13	Flapping	/t/→ [ɾ]	420		51	12.1	6
14	Final stop devoicing	/b/→ [p]		60	2	3.3	1
		/d/→ [t]		210	22	10.5	3
		/g/→ [k]		150	15	10.0	1
		Total		420	39	9.3	3
15	Omission of past tense markers	/t/ or /d/→[ø]		120	24	20.0	4

3. Glottalization of final stops

Glottalization of stops (/b/, /d/, /g/, /p/, /t/ and /k/) in SF was widespread in the production of the speakers, especially realization of /t/ with a glottal stop, which was exhibited by all ten speakers. The occurrence of glottalization of stops ranged from 40.6% to 66.7%, with an average of 46.8%. Voiced stops were glottalized more than voiceless stops.

Examples:

web	[wɛʔ]	up	[ʌʔ]
bread	[breʔ]	cat	[kæʔ]
leg	[leʔ]	duck	[dʌʔ]

4. Vocalization of postvocalic /l/

Vocalization was observed across consonant cluster /l/ (60.0%), syllabic /l/ (55.7%) and consonant /l/ (37.8%) in SF. Vocalization was a prominent feature of MalE pronunciation, as up to nine speakers vocalized consonant cluster and syllabic /l/ in SF.

Examples:

shelf	[ʃɛʊf]	milk	[mɪʊk]
motorcycle	[motosa͡ɪkʊ]	pencil	[pɛnsʊ]
snail	[sneɪʊ]	ill	[ɪʊ]

5. Substitution of labio-dental /v/

Labio-dental /v/ in SF was frequently replaced by /w/ occurring in 33.3% of the total tokens.

Examples:

vacuum cleaner	[wækjum klinə]	vase	[was]
vest	[wɛst]		

6. Omission of /l/

Final consonant deletion was observed only for postvocalic /l/, but not for other final consonants such as stops, fricatives or affricates. It occurred in 21.9% of the tokens (3 speakers) for syllabic /l/. Consonant cluster /l/ omission was more prevalent as four speakers deleted it in 35.0% of the tokens. In these cases, there was no audible trace of a vowel replacing /l/, as happened for /l/ vocalization.

Examples:

girl	[gɜ]	school	[sku]
twinkle	[twɪŋkə]	whistle	[wɪsə]

7. Rhoticity

Post-vocalic /r/ in final position was used by a majority (9) of the speakers. The use of consonant cluster /r/ in SF (34.4%) was more prevalent than singleton consonant /r/ (21.4%) in SF. None of the speakers was consistently rhotic. Most initial consonant and consonant cluster /r/ were realized as post-alveolar approximants which were similar to BrE and AE. However, there were some instances where /r/ was produced as tap or trill. Out of the 990 instances, the occurrence of taps and trills was 3.2% and 0.2% respectively, which was deemed to be non-significant. However, it is worth noting that this indicates that /r/ might not always be realized as a post-alveolar approximant by some Chinese MalE speakers. By contrast, flapped or trilled /r/ might be more common among Malay MalE speakers as in standard Malay, /r/ is realized as a voiced alveolar trill [r] (Asmah, 1977; Thavisak, 2002).

Examples:

lizard	[lɪzɚd]	scissors	[sɪzɚz]
ladder	[lædɚ]	square	[skwɛɚ]

8. Medial Consonant Devoicing

Medial consonant devoicing was observed only in consonant /ʒ/. /ʒ/ was produced as [ʃ] by 4 speakers in 26.7% of the total tokens.

Examples:

television	[tɛlɪvɪʃən]	treasure	[trɛʃə]

9. Consonant cluster reduction

Syllable-final consonant clusters were simplified with the last element of the cluster being elided, especially in clusters with stops, such as nasal + stop (e.g. /nd/, /nt/, /mp/ and /ŋk/) and fricative + stop (e.g. /st/, /ft/ and /sk/) (see Table 3.5 for greater detail on consonant cluster reduction). The last element of these clusters was realized as a glottal stop by 1 speaker in 2 instances. Consonant cluster reduction did not occur in all consonant clusters, for instance, it did not occur in /lt/, /lk/, /lf/ (where /l/ was often vocalized), /ns/, /ntʃ/, /ndʒ/ and /ks/. The occurrence of consonant cluster reduction was most frequent in /nd/ and /nt/.

Examples:

hand	[hæn]	paint	[peɪn]
lamp	[læm]	pink	[pɪŋ]
vest	[vɛs]	lift	[lɪf]
mask	[mæs]		

Table 3.5: The Occurrence of Consonant Cluster Reduction in MalE

No	Consonant Clusters	Consonant Clusters Realizations	Number Of Occurrences	Number of Tokens	Occurrence (%)	Number of Speakers
1	nd	nd→[n]	35	60	58.3	8
2	nt	nt→[n]	53	120	44.2	9
3	st	st→[s]	12	30	40.0	4
4	ft	ft→[f]	9	30	30.0	3
5	mp	mp→[m]	4	30	13.3	2
6	sk	sk→[s]	3	30	10.0	1
7	ŋk	ŋk→[ŋ]	2	60	3.3	1

10. Deaspiration of voiceless stops

Voiceless stops such as syllable-initial /p/, /t/ and /k/ were occasionally produced with minimal aspiration and respectively sounded like /b/, /d/ and /g/ in SE. This occurred in 20.4% of the total tokens for 3 speakers.

Examples:

paint	[peɪn]	teeth	[tɪf]
cat	[kæt]		

11. Use of syllabic /l/

Syllabic /l/ was retained by half of the speakers, in 18.1% of the total tokens.

Examples:

bicycle	[baɪsɪkl]	hospital	[hɒspɪtl]
pencil	[pɛnsl]	vegetable	[vedʒtəbl]

12. Affrication of /dr/, /tr/, /str/

When /r/ is realized as a post-alveolar approximant, it can affect preceding consonants. When /tr/, /dr/ and /str/ clusters are pronounced with lip rounding, the result is [tʃɹ], [dʒɹ] and [ʃtɹ]. Affrication of /dr/, /tr/ and and /str/ was observed in 20%, 10% and 15% respectively of the total tokens in four of the ten participants, with two participants demonstrating /dr/ and /tr/ affrication, and another two /str/ affrication.

Examples:

drum	[dʒrʌm]	dragon	[dʒrægən]
tree	[tʃri]		
strawberry	[ʃtrɔbɛri]	string	[ʃtrɪŋ]

13. Flapping

Intervocalic /t/ was flapped by six speakers in 12.1% of the total tokens.

Examples:

butterfly	[bʌɾeflaɪ]	caterpillar	[kæɾəpɪlə]
computer	[kɒmpjuɾə]	potato	[pəteɾɪo]
watermelon	[wɔɾəmɛlən]	motorcycle	[moɾosaɪkʊ]

14. Final stop devoicing

Final stop devoicing occurred at a lower frequency of occurrence, which ranged from 3.3% to 10.5%, with an average of 9.3%. Devoicing of /d/ (10.5%, 3 speakers) was more common than /b/ (3.3% overall, 1 speaker) and /g/ (10.0% overall, 1 speaker) in terms of occurrence and usage across speakers. The low rate of final stop devoicing is partly explained by the high rate of glottalization of final stops.

Examples:

web	[wɛp]	bread	[bret]
leg	[lek]		

15. Omission of past tense markers

Because of the likelihood of simplification of final consonant clusters, a small number of past tense words, where the past tense morpheme was realized as a consonant cluster, were included in the word list. Past tense marker –ed was omitted in 20.0% of the total tokens in the present study with four of the ten participants not using consonant clusters in the past tense morphemes at all.

Examples:

jumped	[dʒʌmp]	laughed	[laf]
kicked	[kɪk]	played	[pleɪ]

3.3.3 Consonant Realization Summary

The realization features for MalE consonants in the speakers analyzed are summarized and presented in Table 3.6. This overview shows how consonants are being used in MalE, and demonstrates how MalE differs from other varieties of English. Several pairs and sets of consonant in MalE are not distinguished especially in SF. Voiced and voiceless pairs /p, b, t, d, k, g, tʃ, dʒ, f, v, s, z/ may not be distinguished, both being produced as voiceless. The opposition between 'voiced' and 'voiceless' stops, affricates and fricatives is usually signalled in word final position in English with lengthening in the preceding vowel but usually without any voicing (Gimson, 1989; Lisker & Abramson, 1971; Weismer, 1980). When a long vowel preceded a final voiceless consonant in MalE, the consonant was regarded as voiced. However, the majority of the speakers did not always distinguish final voiced and voiceless consonants with voicing or preceding vowel length. Two minimal pairs in the word list were distinguished by final voicing, *played* /pleɪd/ vs *plate* /pleɪt/ and *eyes* /aɪz/ versus *ice* /aɪs/. Most speakers did not regularly distinguish between the word pairs, with two participants using vowel length to differentiate the final consonants 10.0% of the time. Six participants produced final voiced consonants without any lengthening in the preceding vowel 50.0% of the time. Where the vowel was not lengthened, for instance, *web* produced as [wep] with a short vowel, the stop phoneme was regarded as the voiceless member of the pair, e.g. *played* /pleɪd/ [pleɪːt] versus *plate* /pleɪt/ [pleɪt] and *eyes* /aɪz/ [aɪːs] versus *ice* /aɪs/ [aɪs].

Table 3.6: Phonemic Realizations for Consonants in MalE

Affricates	• Syllable-final /dʒ/ may be devoiced.
Fricatives	• Syllable-final /v/ and /z/ may be devoiced. • Syllable-initial /ð/ may be realized as [d]. • Syllable-initial /θ/ may be realized as [t]. • Syllable-final /θ/ may be realized as [f]. • Syllable-initial /v/ may be realized as [w]. • Syllable-initial /ʒ/ may be realized as [ʃ].
Stops	• Syllable-final /b/,/d/, /g/, /p/, /t/ and /k/ may be realized as a glottal stop. • Stop in consonant cluster with element of nasal + stop and fricative + stop in SF may be omitted or glottalized. • Syllable-initial /p/, /t/ and /k/ may be realized as an unaspirated stop. • Intervocalic /t/ may be flapped. • Syllable-final /b/,/d/ and /g/ may be devoiced.
Laterals	• Syllable-final singleton and syllabic /l/ may be vocalized or omitted.
Rhoticity	• Syllable-final /r/, alone or in consonant clusters, may be silent or realized.

3.3.4 Vowel Inventory

The vowel inventory of the present study is listed in Table 3.7 using lexical KEYWORDS from Wells (1982). The repertoire of the participants contained 13 monophthongs and 7 diphthongs. Although the vowel inventory for MalE did not differ from that of other varieties of English, many of the vowels were realized in different ways. Where more than one realization is given, the first is more common. Acoustic analysis will be needed to clarify some of the contrasts. DRESS and TRAP, for example which are merged in SgE (Deterding, 2003), can be very similar with TRAP realized as [ɛ] and DRESS as [ɛ̝]. Confusion between the two vowels can be heightened by spelling with the Malay word for *taxi* being *texi*. The word list contained *dragon* and *egg* with both DRESS and TRAP in a similar raising environment before /g/. Auditorily, all speakers in this study produced *egg* with a closer vowel than *dragon* indicating that there is still some contrast between the two vowels. Acoustic analysis was beyond the scope of this thesis, but would clarify the contrast, if any, between DRESS and TRAP and also any length differentiation for the long/tense and short/lax vowels.

Table 3.7: Vowel Inventory of MalE

KEY WORD (Wells, 1982)	RP Phonemic Symbols (Wells, 1982)	MalE Phonemic Symbols	KEY WORD (Wells, 1982)	RP Phonemic Symbols (Wells, 1982)	MalE Phonemic Symbols
FLEECE	i	i or ɪ	NURSE	ɜ	ɜ or ə
KIT	ɪ	ɪ	STRUT	ʌ	ʌ
DRESS	ɛ	ɛ or e	PRICE	aɪ	aɪ
TRAP	æ	æ	MOUTH	aʊ	aʊ
GOOSE	u	u or ʊ	CHOICE	ɔɪ	ɔɪ
FOOT	ʊ	ʊ	FACE	eɪ	eɪ or e
THOUGHT	ɔ	ɔ	GOAT	əʊ	o, oʊ
LOT	ɒ	ɒ	NEAR	ɪə	ɪə
START	ɑ	a	SQUARE	ɛə	ɛ or ɛə
COMMA	ə	ə	CURE	ʊə	Not tested

Where two symbols are given, the first is more common.

3.3.5 Phonological Features of Vowels

The occurrence of the vowel features found in MalE is displayed in Table 3.8. The vowel features of MalE were analyzed according to the percentage of occurrence and number of speakers exhibiting the features. There were four major vowel features observed.

Table 3.8: Phonological Features of Vowels in MalE

No	Vowel Realizations		Number of Tokens	Number of Occurrences	Occurrence (%)	Number of speakers
16	Simplification of diphthongs	/əʊ/→[o]	450	360	80.0	10
		/əʊ/→[oʊ]		75	16.7	7
		/ɛə/→[ɛ]	210	146	69.5	9
		/eɪ/→[e]	360	113	31.4	7
17	Use of full vowels for reduced vowels	-	630	288	45.7	9
18	Shortening of long vowels	/i/→[ɪ] /u/→[ʊ] /ɜ/→[ə] /ɔ/→[ɒ] /a/→[ʌ]	330 180 120 240 300	116 55 27 46 15	35.2 30.7 22.5 19.2 5.0	5 6 3 5 5
	Lengthening of short vowels	/ʊ/→[u] /ɒ/→[ɔ] /ʌ/→[a] /ɪ/→[i] /ə/→[ɜ]	120 450 450 930 1950	6 12 12 0 0	5.0 2.7 2.7 0.0 0.0	2 4 2 0 0
19	Deletion of unstressed syllables	-	90	18	20.0	3

16. Simplification of diphthongs

Simplification of diphthongs was shown with different degrees of occurrence. The diphthong /əʊ/ was either realized as a monophthong [o] in 80.0% of the tokens or as a diphthongs resembling the AmE [oʊ] rather than a more Received Pronunciation (RP) like [əʊ]. All the speakers used [o] for /əʊ/ and seven speakers used [oʊ] for /əʊ/. Diphthong /ɛə/ was realized as monophthong [ɛ] in 69.5% of the tokens and by 9 of the speakers. The use of monophthong [e] for diphthong /eɪ/ was also quite common, with an occurrence in 31.4% of the total tokens and used by seven speakers.

Examples:

yellow	[jɛlo]	nose	[noz]
pear	[pɛ]	square	[skwɛ]
radio	[redio]	spray	[spre]

17. Use of full vowels for reduced vowels

In the polysyllabic words of Received Pronunciation (RP), syllables before the primary stress are usually reduced. However, nine of the ten participants in the present study realized such syllables with a full vowel in 45.7% of the 630 instances. The substitution of schwa corresponded with the orthography, notably words with letter ‘u’ and ‘o’, for example, *octopus* [ɒktopus], *motorcycle* [motosaɪkʊ] and *policeman* [polismən]. A full vowel is an acceptable alternative for some polysyllabic words in BrE with *ambulance*, for example, listed with a full vowel by both Jones (2003) and Wells (2000). Nevertheless, the use of full vowels in unstressed syllables is much higher in MalE than BrE.

Examples:

aeroplane	[ɛropleɪn]	hippopotamus	[hɪpopɒtəməs]
potato	[poteɪto]	tomato	[tomato]

18. Lack of long and short vowel distinction

Some participants in the present study did not consistently distinguish long and short vowels. Words with long vowels showed a greater tendency to be realized as short vowels. For example, /i/→ [ɪ] (35.2% of total tokens, 5 speakers) and /u/→ [ʊ] (30.7%

of total tokens, 6 speakers), /ɜ/→ [ə] (22.5% of total tokens, 3 speakers) /ɔ/→ [ɒ] (19.2% of total tokens, 5 speakers). Due to the lack of long and short vowel distinctions, short vowels were occasionally lengthened, but the occurrence was not as high as shortening of long vowels. For instance, /ʊ/→ [u] (5.0% of total tokens, 2 speakers), /ɒ/→ [ɔ] (2.7% of total tokens, 4 speakers) and /ʌ/→ [a] (2.7% of total tokens, 2 speakers). /ɪ/ and /ə/ were not lengthened by any of the participants.

Examples:

beach	[bɪtʃ]	teeth	[tɪf]
foot	[fʊt]	moon	[mʊn]
bird	[bəd]	girl	[gəl]

19. Deletion of unstressed syllables

Most participants produced words like *camera* and *strawberry* as three syllables and *vegetable* as four syllables. However, unstressed syllables in these polysyllabic words were deleted in 20% of the tokens by three participants. In such a case, deletion of unstressed syllables as in other varieties of English (Australian English, New Zealand English) was observed in MalE too.

Examples:

camera	[kæmrə]	vegetable	[vedʒtəbʊ]
strawberry	[strɔbri]		

3.3.6 Vowel Realization Summary

The realization features for MalE vowels in the speakers analyzed are summarized and presented in Table 3.9. This table explains how vowels are generally being used in MalE, and shows how MalE differs from other varieties of English.

Table 3.9: Phonemic Realizations for Vowels in MalE

Vowels	• Diphthong /əʊ/ may be realized as monophthong [o] as [oʊ]. • Diphthong /ɛə/ may be realized as monophthong [ɛ]. • Diphthong /eɪ/ may be realized as monophthong [e]. • /i/ may be realized as [ɪ]. • /u/ may be realized as [ʊ]or vice versa • /ɔ/ may be realized as [ɒ] or vice versa. • /a/ may be realized as [ʌ] or vice versa. • /ɜ/ may be realized as [ə]. • Schwa in multisyllabic words may be realized as a full vowel.

3.3.7 Influences and Interference Patterns within Malaysian English

MalE is as a variety of English which has evolved under a number of influences, notably BrE, AmE, local languages and dialects. The consonant and vowel features of MalE observed in the present study were grouped into categories according to these possible influences in order to show the association of phonological realization with these influences (Table 3.10). Among the 19 features observed, final stop devoicing, vocalization of /l/ and affrication of /dr/, /tr/ and /str/ are purely phonetic or articulatory in nature, and could occur in any native English variety. Vocalization is reported to be a prominent characteristic of many varieties of English such as BrE (Wells, 1982), New Zealand English (Horvath & Horvath, 2001; Maclagan, 2000), Australian English (Horvath & Horvath, 2001) and Singapore English (Deterding, 2007). In many accents of English, syllable-initial /tr/ and /dr/ are pronounced as post-alveolar affricates [tʃr] and [dʒr] (Lance & Howie, 1997; Laver, 1993; Wells, 1990) and /str/ as [ʃtr] (Bauer & Warren, 2004; Durian, 2004; Janda & Joseph, 2003; Labov, 1984; Lawrence, 2000; Maclagan, 2000; Shapiro, 1995). Affrication of /tr/, /dr/ and /str/ demonstrates that MalE is currently undergoing changes which are moving in parallel with other varieties of English worldwide. Therefore, these changes are not exclusive to MalE. The use of syllabic /l/ could be specifically attributed to influence from BrE and shows that some of the MalE speakers retain the production of BrE features. Flapping of intervocalic /t/ is a common feature of North AE (Demirezen, 2006; Giegerich, 1992). The occurrence of flapping was relatively high in MalE. Of the American features studied, post-vocalic /r/ was by far the most common reported elsewhere. Half of the participants in the present study presented with rhoticity in their reading of wordlists. This was probably due to the influence of AmE which contributed to the evolution of MalE. The remaining 12 phonological features probably reflect influence from the local languages.

The interference patterns within MalE resulting from the influence of local languages (Mandarin Chinese and Malay) and Chinese dialects are further discussed in Table 3.11. All the 12 features are possibly influenced by Mandarin Chinese, Malay and Chinese dialects except glottalization of final stops and vocalization and omission of /l/ which might only influenced by one or two of the languages. Glottalization might be due to the influence of Malay and Chinese dialects such as Hokkien, Cantonese and Teochew as well as a variety of Mandarin Chinese used in Malaysia which contain glottal stops in syllable-final positions. Bao (1998) suggested that the occurrence of glottalization is influenced by the phonology of substrate languages, mainly Malay and the Chinese languages and dialects. All final stops in Malay are realized as glottal stops and stops are generally not released in Chinese dialects such as Hokkien and Cantonese. Another possible reason for the high occurrence of glottalization is influence from the extensive borrowing of English words into Malay (Tan, 1998). For instance, Malay for *rocket* is *roket* [rɔkeʔ], *music* is *muzik* [muziʔ], *skirt* is *skirt* [skəʔ] and *zip* is *zip* [ziʔ]. It is not surprising that these words tend to be pronounced with glottal stops in English. The use of /l/ in SF position is preserved in Malay, so vocalization and omission of /l/ might be due to the influence of Mandarin Chinese and Chinese dialects.

Table 3.10: Phonological Features According to Types of Possible Influences

Possible Influences	Phonological Features	
	Consonants	Vowels
Influence from local languages (Mandarin Chinese or Malay) or Chinese dialects	• Final consonant devoicing • Dental fricative avoidance • Glottalization of final stops • Final consonant /l/ omission and • Vocalization • Substitution of labiodental /v/ • Medial consonant /ʒ/ devoicing • Deaspiration of voiceless stops • Final stop cluster reduction • Omission of morphological markers	• Simplification of diphthongs • Lack of vowel length distinction • Use of a full vowel in unstressed syllables
Influence from BrE	• Use of syllabic /l/	
Influence from AE	• Flapping of intervocalic /t/ • Rhoticity	

Table 3.11: Interference Patterns within MalE

No	Consonant Realizations	Mandarin Chinese	Malay	Chinese Dialects
1	Final consonant devoicing	/	/	/
2	Dental fricative avoidance	/	/	/
3	Glottalization of final stops	*/	/	/
4	Vocalization and omission of /l/	/	X	/
5	Substitution of /v/ with /w/	/	/	/
6	Medial consonant /ʒ/ devoicing	/	/	/
7	Final consonant clusters reduction	/	/	/
8	Deaspiration of voiceless stops	/	/	/
9	Omission of morphological markers	/	/	/
10	Simplification of diphthongs	/	/	/
11	Lack of vowel length distinction	/	/	/
12	Use of a full vowel in unstressed syllables	/	/	/

(/) Yes (X) No

* Glottalization might occur in the variety of Mandarin Chinese spoken in Malaysia, although glottalization is not a feature of Standard Mandarin Chinese.

3.4 DISCUSSION

In spite of the fact that not all the adult speakers used /θ/ and /ð/, MalE does not differ in its consonant and vowel inventory compared with BrE and AE. However, the realizations of these phonemes are unique to MalE. For instance, devoicing of fricatives, final consonant cluster reduction and lack of long and short vowel distinctions are commonly demonstrated by MalE speakers, so that the realization [lɪf] may refer to *leaf*, *leave*, *live* and *lift*. MalE, appears as a simplified version of SE as the phonological system of MalE is simpler compared to SE. For instance, the changes found in the phonological features of final consonant devoicing, dental fricative avoidance, glottalization of final stops, final consonant /l/ omission and vocalization, substitution of labiodental /v/ and final consonant cluster reduction, involve either substitution or omission of sounds.

The development of MalE dialectal features could be explained from the perspective of interference from the phonological system of Mandarin Chinese and Malay as well as similarity in terms of shared and unshared sounds of English, Mandarin Chinese and Malay (Fabiano-Smith & Goldstein, 2010; Flege, 1981, 1987; Goldstein, Fabiano, & Iglesias, 2003). The interference patterns of Mandarin Chinese and Malay in terms of syllable structure might also help to account for MalE phonological features. Both Mandarin Chinese and Malay have fewer syllable-final consonants, so MalE speaking adults might find them difficulty to produce. Many phonological features of MalE occur in SF, for instance, final consonant devoicing, dental fricative avoidance, glottalization of final stops, final consonant /l/ omission and vocalization, final consonant cluster reduction and omission of morphological markers. Sounds in SF are substituted with a sound which has similar phonetic features, for example, final voiced consonants are replaced with their voiceless counterparts. From the point of shared and unshared sounds of English, Mandarin Chinese and Malay, many sounds that have undergone changes in MalE were unshared sounds. In consonants, for instance, /v/, /z/, /ʒ/, /ð/ and /θ/ are unshared sounds specific to English. Syllable-initial and syllable-final /v/ was produced as [w] and [f] respectively. Syllable-final /z/ and syllable-initial /ʒ/ were devoiced. Syllable-initial /ð/ and /θ/ were produced as alveolar stops and syllable-final /θ/ was realized as [f]. As for vowels, all long and tense vowels are unshared vowels which are specific to English, thus the lack of vowel length distinction in MalE is to be expected. Some of the consonant and vowel errors predicted by Zhao (1995) for Chinese speakers of English are evident in the present study, implying the influence of Mandarin Chinese on Chinese-influenced MalE. For example, /v/ is absent from Mandarin Chinese, therefore, [w] and [f] are substituted for /v/, with [f] substitution in coda position. However, some phonological features are unique to MalE, and might be influenced by Malay, for example, glottalization of final stops. Some phonological features are possibly influenced by an interaction between Mandarin Chinese, Chinese dialects and Malay. For instance, aspiration is used in Mandarin Chinese and Chinese dialects to distinguish stops phonemically. But the intensity of aspiration is less intense in /p^h, t^h, k^h/ as compared to English which may lead to confusion with English /b, d, g/ as a result of differences in degree of aspiration. Stops are differentiated by voicing in Malay. Therefore, voiced stops of English are similar to unvoiced stops in Malay. Thus, the deaspiration of syllable-initial voiceless stops might be also due to influence from Malay (Deterding & Poedjosoedarmo, 1998).

Information about dialectal features is essential in describing dialectal speaking children's phonological development. This is because an understanding of dialectal features will help to differentiate dialect specific phonological features exhibited by dialectal English speaking children from phonological differences and disorders. In the Malaysian context, it is important to determine whether the phonological differences exhibited by MalE speaking children are due to normal variation of MalE or underlying phonological disorders. Unless SLPs have a basic knowledge of the phonological differences between MalE and other varieties of English, it will be difficult to determine whether a MalE speaking child has a phonological disorder. As there is lack of resources about the phonological features of MalE, it is possible that a speech-language pathologist might believe that an individual has a phonological disorder because of incorrect speech productions resulting from normal variation of MalE.

An understanding of dialectal features not only helps in distinguishing differences and disorders, it also helps in differentiating dialectal and normal developmental patterns in children's phonological systems. Lin and Johnson (2010) claimed that it is difficult to determine whether a bilingual child's phonological error pattern was caused by cross-linguistic phonological influence or a still-developing phonological system. In such a case, the model of adults' speech will be useful to determine the cross-linguistic phonological influence which will be likely to persist into adulthood. Many of the phonological features of MalE converge with developmental phonological processes of Standard English (SE) children. Table 3.12 lists the dialectal features of MalE which converge with developmental phonological processes of SE speaking children. It is believed that if the adults' speech model of MalE is not studied, MalE features exhibited by typically developing MalE speaking children might be regarded as a still-developing phonological system. For instance, deaspiration of initial voiceless stops is akin with prevocalic voicing in SE. SI voiceless stops /p, t, k/ are often aspirated to a far lesser degree in MalE than in BrE or AmE. This may lead to the production being perceived as a voiced plosive /b, d, g/. Prevocalic voicing usually no longer persists in typically developing SE speaking children after 3 years old (Stoel-Gammon & Dunn, 1985). However, deaspiration of initial voiceless stops will persist into adulthood for MalE speaking children as it is one of the dialectal features of MalE. Postvocalic /l/ deletion is another common dialectal features of MalE. This may be regarded as part of final consonant deletion. Final consonant deletion commonly refers to deletion of syllable-final consonants such as liquids, stops, fricatives or affricates. However, final consonant deletion will disappear by age of three years old (Stoel-Gammon & Dunn, 1985). The persistence of this process after three years old is an early indicator of phonological deviancy. Therefore, when postvocalic /l/ deletion persists in

MalE speaking children after 3 years old, they may be regarded as having delayed phonological development if MalE dialectal features are not considered.

Table 3.12: Convergence of MalE and SE Phonological Processes

Dialectal Phonological Processes	Developmental Phonological Processes
Glottalization of Stops	Glottal Replacement
Devoicing of Stops	Postvocalic Devoicing
Deaspiration of Voiceless Stops	Prevocalic Voicing
Final Consonant Devoicing	Postvocalic Devoicing
TH-Stopping	TH-Stopping
TH-Fronting (SF)	TH-Fronting (SI and SF)
Vocalization	Vocalization
Omission of Final /l/	Final Consonant Deletion
Final Stop Cluster Reduction	Final Consonant Cluster Reduction
Simplification of Diphthongs	Vowel Changes / Alterations
Vowel Merging	Vowel Changes / Alterations
Use of Full Vowel for Unstressed Vowel	Vowel Changes / Alterations

The data derived from this study of adult speakers of MalE will serve as a reference in the phonological assessment of MalE speaking children in the main study presented in this thesis. The phonological features demonstrated by MalE adult speakers will be regarded as acceptable dialectal variations, so that MalE children who exhibit the same dialectal variations will be regarded as appropriate and not penalized. However, it should always be remembered that not all ME speakers demonstrate similar phonological patterns due to individual differences. It is worth emphasizing that the phonological features of MalE do not occur all the time in MalE. The features outlined occur with some speakers and not all the speakers. Thus, a careful interpretation is needed across individual speakers. Therefore SLPs should always compare the child's speech with that of other members of the family whose speech may serve as the most appropriate underlying form against which to compare the child's surface productions.

CHAPTER 4
METHODOLOGY FOR THE NORMATIVE STUDY OF CHILDREN'S PHONOLOGICAL DEVELOPMENT

4.0 INTRODUCTION

The methods used in the collection and analysis of data play an important part in the study of phonological development. The purpose of this chapter was to describe the methodologies used in the major section of this thesis, which was the phonological development of Malaysian English speaking Chinese children.

4.1 PARTICIPANTS

4.1.1 Targeted Participants

Typically developing children in the age range of 3 to 7 years old were identified to participate in the study as the majority of children referred for speech-language therapy services are from this age range (Ozanne, 1995; Shriberg & Kwiatkowski, 1994; Young, 1991). The target number of participants was 300, with 60 in each of the five age groups, 3-, 4-, 5-, 6- and 7- years. Each group was further divided into 2 subgroups or cells with equal number of males and females. In other words, each cell contained 30 subjects. Cohen (1988) reported that this number would reveal a small effect between groups in a power analysis. 30 participants per cell should lead to about 80% power (the minimum suggested power for an ordinary study). Gay (1995) proposed that in the case of a correlational study seeking to establish associative relations between variables, the sample should include a minimum of 30 subjects.

4.1.2 Sampling Procedures

Participants were located using non-random sampling methods. Both consecutive and snowball sampling were used to recruit participants. Consecutive sampling involves selecting all individuals who agree to participate, provided they meet the pre-established criteria, until the numbers of subjects desired have been recruited. This sampling method was used as the subject pool is limited. Snowball sampling is a useful technique for recruiting a sample of subjects when an investigator has limited contact with a targeted population. In such cases, one or more identified participants can be asked to identify others in the population as prospective candidates for study. Through the use of such personal networks, the sample can be made to "snowball" or increase in size.

Snowball sampling was mainly used to locate 3 year olds because some children at this age were not yet attending nursery or kindergarten. They were solicited through a variety of sources, including participants' siblings, colleagues and friends. Researchers asked participants to nominate potential participants they knew and then these people were invited to participate in the research (Bowling, 1997).

4.1.3 Selection of Participants

To locate subjects for the study, kindergartens, child-care centres, nurseries and schools in Penang Island were invited to participate in the study. *Information Letters* (Appendix C) about the study were sent to principal and teachers to explain the purpose of the study. They were requested to identify potential subjects in their kindergartens, child-care centres, nurseries or schools. *Teacher's Questionnaires* (Appendix D) were disseminated to teachers to confirm the social history as well as language usage and proficiency of participating children. *Information Letters* (Appendix E) were distributed to parents of the selected children to explain the project and seek their permission for the children to participate in the study. Concurrently, parents were also asked to complete the *Parental Questionnaires* (Appendix F) in the areas of general developmental and language history. Once all the *Parental Questionnaires* were received, the subjects who met the inclusion criteria were confirmed by asking parents to sign the *Consent Letters* (Appendix G). The first 30 children in each age group who met the inclusion criteria were selected.

The inclusion criteria for children in the study were:

i. In the age range of 3 to 7 years old
ii. Typically developing children with no delay in personal developmental milestones including medical, hearing, speech and language as reported in the *Parental Questionnaire* as well as no suspicion of physical, behavioural and academic problems as stated in the *Teacher's Questionnaire*
iii. Of Chinese ethnicity or descent whose parent's educational level should be at secondary level or even higher
iv. Exposed to English with at least 20% of exposure at school or home in their daily routine currently
v. Rated to have at least 3 on a scale of 0 to 4 for amount and proficiency of English use (refer to Tables 4.7 and 4.8 where the details of the scale are) in the school or at home in accordance with report from the *Teacher's Questionnaire*

or *Parental Questionnaire*. Based on the scale of 3 for amount of English usage, children had to at least "*speak English sometimes, hears it most of the time*". On the other hand, based on the scale of 4 for proficiency of English use, children had to have at least "*good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said* ". These criteria were drawn based on previous bilingual studies. The minimum percentage of language input was set at 20% based on studies suggesting that a child may need at least 20% of exposure to a language in order to produce utterances in that language spontaneously (Pearson, Lewedeg, & Oller, 1997; Schiff & Ventry, 1976). According to Schiff and Ventry (1976), hearing children of deaf parents who spent 10 hours a week with hearing adults were able to develop age appropriate English skills. Thus, a minimum of 10 hours per week (equivalent to 20% of the time) was assumed to be necessary to develop linguistic skills in each language. A conservative rating of 3 for language use and proficiency level in school or at home was selected to reflect the fact that children, who are proficient in a language, may not use it in certain contexts. For example, a child might only use English with teachers in the school. Furthermore, bilingual Malaysian children will code-switch from one language to the other language depending on different situations or contexts.

4.1.4 Selected Participants

The particulars of participants recruited in the present study are displayed in Table 4.1. A total of 264 children were recruited, with 139 females and 125 males between age 3 and 7 years. There was an incongruity between the target of 30 participants in each sub age group and the actual number of participants recruited, namely for group 3;00-3;05 and 6;06-6;11. This occurred because lack of resources in the recruitment of younger children, resulting in fewer participants in the 3;00-3;05 group. The majority of younger children were still not attending nursery at the time of data collection. As for group the 6;06-6;11, many of the participants fell into the age range of 6;00-6;05 when data collection was carried out. It was not possible to return from New Zealand to Malaysia to fill the gaps in the data collection.

Table 4.1: The Distribution of Participants by Age and Gender

Age Group	Age		Gender		Total Number (n)
	Mean (year; month)	SD (month)	Female	Male	
3;00-3;05	3;02	1.9	8	7	15
3;06-3;11	3;10	1.3	16	10	26
4;00-4;05	4;03	1.6	14	15	29
4;06-4;11	4;09	1.6	15	15	30
5;00-5;05	5;02	1.5	15	15	30
5;06-5;11	5;08	1.4	15	15	30
6;00-6;05	6;03	1.4	16	15	31
6;06-6;11	6;08	1.8	9	4	13
7;00-7;05	7;03	1.5	15	15	30
7;06-7;11	7;07	1.1	16	14	30
Total			139	125	264

Parents Education Level

Most of the children' parents had an educational level of secondary and above with less than 3% who had primary educational level (Table 4.2).

Table 4.2: Parents' Educational Level

Educational Level	Father		Mother	
	n	%	n	%
Primary	5	1.89	1	0.38
Secondary	112	42.42	132	50.00
Tertiary	144	54.55	131	49.62
Unknown	3	1.13	0	0
Total	264	100.0	264	100

Age of Exposure to Different Languages at Home

As can be seen from Table 4.3, a higher number of children was exposed to Mandarin Chinese (65.15%) since birth than to English (50.00%), Malay (6.06%) and Chinese dialects (28.03). More than 90% of the children were exposed to English and Mandarin Chinese before 4 years old at home. Less than 50% of the children were exposed to both Malay and Chinese dialects before 4 years old, indicating that Malay and Chinese dialects were less commonly used compared to English and Mandarin Chinese.

Table 4.3: Age of Exposure to Different Languages at Home

Languages	English		Mandarin Chinese		Malay		Chinese Dialects	
Age	n	%	n	%	n	%	n	%
birth	132	50.00	172	65.15	16	6.06	74	28.03
1	44	16.67	26	9.85	13	4.92	19	7.20
2	39	14.77	20	7.58	24	9.09	13	4.92
3	32	12.12	26	9.85	68	25.76	15	5.68
4	15	5.68	10	3.79	53	20.08	8	3.03
5	2	0.76	6	2.27	26	9.85	6	2.27
6	0	0	1	0.38	6	2.27	4	1.52
7	0	0	0	0	1	0.38	1	0.38
na	0	0	3	1.14	57	21.59	99	37.50

na - not available

Age of Exposure to English - Mandarin Chinese

Table 4.4 shows the number of children who were at least bilingual in English-Mandarin Chinese at different age levels. Approximately 34% of the children were bilingual since birth. By age 3 years and younger, more than 87% of the participants were bilingual. Participants who acquired English and Mandarin Chinese by age 3 years and younger were considered “simultaneous bilingual”, and participants who acquired English and Mandarin after 3 years of age were considered “sequential bilingual”.[3]

Table 4.4: Age of Exposure to English - Mandarin Chinese

Age	Number of Children	% of Children
birth	91	34.47
1	135	51.14
2	170	64.39
3	230	87.12
4	253	95.83
5	260	98.48
6	261	98.87
na	3	1.14

na - not available

Number and Types of Chinese Dialects Used at Home

The number and types of Chinese dialects used by the children are shown in Table 4.5. 37.5% of the children did not use dialect at all. Out of 62.5% of children who used dialects at home, approximately 85% of them used just one dialect and the rest used two

[3] Paired t-tests were performed to examine the differences in phoneme accuracy in the two groups of children: simultaneous and sequential bilinguals. The results showed that there was no significant difference between these two groups of children across all the age groups in terms of phoneme accuracy. Therefore, simultaneous and sequential bilingual children are combined in the rest of this thesis.

dialects. There were many types of Chinese dialects being used. The majority of the children used Hokkien (74.49%), followed by Cantonese (14.80%) and Teochew (5.10%). Other dialects used included Hakka, Sin Hua and Hainan.

Table 4.5: Number and Types of Chinese Dialects Used at Home

Detail	Number			Types			
	none	one	two	Hokkien	Cantonese	Teochew	Other
n	99	139	26	146	29	10	11
%	37.50	52.65	9.85	74.49	14.80	5.10	5.61

Years and Percentage of Exposure to Languages

The years and percentage of children' exposure to different languages at home and in the school were calculated based on the parent and teacher reports and are displayed in Table 4.6. The number of years of exposure to English and Mandarin Chinese increased as age increased, respectively with an average of 3.03 years and 2.88 years for age group 3;00-3;11 and 6.06 years and 6.51 years for age group 7;00-7;11. Among four languages reported, Chinese Dialects were only used as home languages and were not used in the school setting. The percentage of exposure to English was higher in the school compared to at home across all age groups, except for age group 7;00-7;11. This was because the majority of the children from this age group were recruited from a Chinese medium school. The other younger participants were recruited from kindergartens where both English and Mandarin Chinese were officially used. The percentage of exposure to Mandarin Chinese was higher at home relative to in the school across all age groups. Participants' exposure to Malay both at home and in the school remained fairly low.

Table 4.6: Years and Percentage of Participants' Exposure to Languages

Age Group	Details	Years of Exposure (Parents' report)		% of Exposure at Home (Parents' report)				% of Exposure in the School (Teachers' report)		
		E	MC	E	MC	M	D	E	MC	M
3;00-3;11	Mean	3.03	2.88	37.80	43.17	4.15	14.88	55.61	34.39	10.00
	SD	0.95	1.19	18.10	26.02	6.70	18.72	23.88	22.03	8.94
4;00-4;11	Mean	3.39	3.44	37.80	49.66	6.78	5.42	48.14	39.49	12.20
	SD	1.19	1.42	20.18	23.56	10.90	10.23	20.13	21.93	10.52
5;00-5;11	Mean	4.18	4.65	35.34	44.33	8.00	11.67	50.17	38.50	11.33
	SD	1.49	1.57	17.40	18.45	9.35	14.52	23.32	22.61	9.11
6;00-6;11	Mean	5.31	5.40	35.23	44.09	6.59	14.09	46.82	42.50	10.68
	SD	1.42	1.70	17.72	21.60	7.76	20.04	25.68	23.83	7.28
7;00-7;11	Mean	6.06	6.51	30.00	52.00	8.17	9.83	21.33	69.00	9.67
	SD	1.32	1.48	16.77	22.98	8.73	14.55	9.47	7.96	1.81

E - English MC- Mandarin Chinese M- Malay D- Chinese Dialects

Parents' and Teachers' Rating of Amount of Language Usage and Proficiency Level

All the children were rated to have at least 3 for amount of English use and proficiency in the school based on the teachers' reports as shown in Table 4.7. Parents' rating of children's amount of English usage and proficiency level ranged from 1 to 4 (see Table 4.8).

Table 4.7: Teachers' Rating of Amount of Language Usage and Proficiency Level

Rating	Amount of Usage				Proficiency Level			
	E		MC		E		MC	
	n	%	n	%	n	%	n	%
0	0	0	0	0	0	0	0	0
1	0	0	15	5.68	0	0	9	3.41
2	0	0	21	7.95	0	0	16	6.06
3	167	63.26	75	28.41	214	81.06	90	34.09
4	86	32.58	133	50.38	50	18.94	129	48.86
DK	11	4.17	5	1.89	0	0	5	1.89
NA	0	0	15	5.68	0	0	15	5.68

Table 4.8: Parents' Rating of Amount of Language Usage and Proficiency Level

Rating	Amount				Proficiency			
	E		MC		E		MC	
	n	%	n	%	n	%	n	%
0	0	0	1	0.38	0	0	10	3.79
1	0	0	9	3.41	8	3.03	16	6.06
2	52	19.70	21	7.95	127	48.11	49	18.56
3	117	44.32	57	21.59	106	40.15	118	44.70
4	95	35.98	175	66.29	23	8.71	69	26.14
DK	0	0	1	0.38	0	0	2	0.76
NA	0	0	0	0	0	0	0	0

<u>Rating of Amount of Usage</u>
0 - Never speaks English, never hears it.
1 - Never speaks English, hears it very little.
2- Speaks English a little, hears it sometimes.
3 - Speaks English sometimes, hears it most of the time.
4 - Speaks English all of the time, hears it all of the time.
DK - Don't know
NA - Not available

<u>Rating of Proficiency Level</u>
0 - Non-proficiency, cannot speak English, has only a few words or phrases, cannot produce sentences, only understands a few words
1 - Very limited proficiency, cannot speak English, has a few words or phrases, understands the general idea of what is being said
2 - Limited proficiency with grammatical errors, limited vocabulary, understands the general idea of what is being said.
3 - Good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said.
4 - Nativelike proficiency with few grammatical errors, good vocabulary, understands most of what is said.
DK - Don't know
NA - Not available

Relatively, the teachers rated the children's amount of English usage and proficiency of English higher than the parents did. This discrepancy could be explained in that teachers compared the children's English performances with their peers whereas parents compared their children's English skills relative to other languages such as Mandarin Chinese and Chinese dialects. Another possible reason is the nature of school system where children were granted ample opportunity to use English in the school compared to at home.

4.2 SPEECH STIMULI

4.2.1 Type of Speech Sample

Single word picture naming was chosen as the medium to elicit the corpus of speech from the children. From the standpoint of widespread usage, analyzing speech sound productions in a corpus of single-word productions has been a common method for assessing speech sounds (Arlt & Goodban, 1976; Chirlian & Sharpley, 1982; Dodd, Holm, Hua, & Crosbie, 2003; Kilminster & Laird, 1978; Moyle, 2005; Poole, 1934; Porter & Hodson, 2001; Prather, Hedrick, & Kern, 1974; Smit, Hand, Bernthal, Freilinger, & Bird, 1990; Templin, 1957; Wellman, Case, Mengert, & Bradbury, 1931).
The major strengths of single word naming are: a) it is usually simple and relatively easy to administer; b) it is easier to determine and transcribe due to a predetermined word list; c) it provides control over the speech sample as it contains specifically designed sounds in a variety of word positions and phonetic contexts; d) it can be administered to a group of children, thus providing comparable data sets across children and e) it can be administered again at a later date to assess a child's progress over time (Stoel-Gammon & Dunn, 1985; Wolk & Meisler, 1998). There are issues regarding the accuracy of single word testing as compared to spontaneous conversation. Some clinicians suggest that phonological analyses should almost exclusively be based on spontaneous speech samples, as spontaneous connected speech samples are the most valid or representative sample of phonological performance (Shriberg and Kwiatkowski, 1980; Stoel-Gammon and Dunn, 1985; Morrison and Shriberg, 1992). Faircloth and Faircloth (1970) and DuBois and Bernthal (1978) reported differences in specific speech sound errors identified with single-word tests and those identified with conversational speech samples. On the other hand, Shriberg and Kwiatkowski (1980) reported a non-significant correlation between responses obtained through single-word and connected speech samples. Kenny, Prather, Mooney and Jeruzal (1984) found that

there was no difference among three sampling procedures: single word test, nonsense test and story-retell for type and number of errors in terms of articulatory responses. Therefore, it is difficult to draw conclusions regarding the superiority of conversational speech over single word naming. According to Wolk and Meisler (1998), a carefully designed picture naming task may tap the child's phonological system more deeply and provide the author with maximum control over the speech sample to obtain a rich body of data. Therefore, an extensive picture-naming task may provide a good sample of phonological behaviour while avoiding difficulties inherent in the collection and transcription of conversational speech. As the advantages of single word picture naming outweigh conversational speech, single word naming test was employed in this study.

4.2.2 Development of stimuli

In this study, a picture-naming task which contained a list of words was developed in order to obtain a large and well-controlled speech sample. Words were selected according to 9 essential criteria. They were size of sample, phonetic inventories, phonetic context, syllable position, syllable structure and word length, syllable stress, morphological markers, word familiarity and syntactic classes of words.

4.2.2.1 Size of sample

The first criterion was that the number of words was to be large enough to obtain sufficient speech data. There were 195 words in the speech sample in the present study. Two hundred words are deemed to yield a representative sample of speech (Elbert & Gierut, 1986; Grunwell, 1982, 1985; Stoel-Gammon & Dunn, 1985). Wolk and Meisler (1998) and James (2001) respectively include 162 and 199 stimulus items in their single picture naming task, providing an adequate opportunity to elicit a wide range of words which vary in syllable structure and length.

4.2.2.2 Speech sound inventories

Elbert and Gierut (1986) stated that the sample should contain all target sounds or phonemes in the language. These include singleton consonants, consonant clusters, vowels and diphthongs. There are 24 consonants, 13 monophthongs and 7 diphthongs in MalE (Baskaran, 2004; Chapter 3). In studies of phonological development, more researchers focus on consonants vowels rather than vowels (Hargrove, 1982), reflecting an obvious imbalance between researchers' interest in consonants and vowels (Butcher, 1989). This lack of attention is significantly manifested in clinical procedures, as many tests and analysis procedures do not include vowels (James, van Doorn, & Mcleod, 2001a,b). All vowels should be included in this study because of the evidence of development after the age of 3 years as well as the value of vowels as a predictive tool for children with speech impairment (Dodd & McCormack, 1995; Hargrove, 1982). The inclusion of vowels in the present study is especially essential as the data about vowel development of MalE speaking children has not yet been reported. The same applies to consonant clusters. Few of the commonly used articulation and phonology tests comprehensively sample consonant clusters (McLeod, 1997; Powell, 1994). Grunwell (1981) reported that unintelligible children rarely produce sequences of consonants, such as clusters or abutting consonants within a word. Thus, consonant clusters should be sampled thoroughly across initial and final syllable positions. In the present study, consonants (Appendix H), consonant clusters (Appendix I) and vowels (Appendix J) were thoroughly sampled.

4.2.2.3 Phonetic context

The phonetic context of a target sound may determine how that sound is produced. Phonetic context is varied by systematically changing the segment that immediately precedes or follows the target sound. It has been suggested that sounds are often easier to produce in some contexts as opposed to others, thus resulting in inconsistency in production during the phonological acquisition period. For instance, the /k/ sound in *cat* tends to be assimilated into /t/ while the initial /k/ in *cake* is usually not assimilated by younger children. Gallagher and Shriner (1975) reported that children's /s/ productions were affected by position in CCV consonant clusters. Curtis and Hardy (1959) reported that /r/ was more likely to be produced correctly in consonant clusters than in single phoneme productions. Thus, analyzing a child's phonological system based on a single production of each phoneme does not truly reflect children' habitual speech. Therefore, in the present study, the phonemes were sampled in several different words in order to provide more opportunities of production. For example, consonant /p/ was elicited in word initial position with 17 occurrences in the sample. Consonant /p/ appeared in different phonetic contexts such as *pear (CV), pig (CVC), plate (CCV-), pink (CVCC), present (CCXS)* and *pillow (XS)*, see Appendix K for detail.

4.2.2.4 Syllable-word position

In the study of phonological development, the consideration of consonant development is mostly focused on word position. Word positions are described regardless of phonetic environment and syllable boundaries. In the present study, all consonants in MalE were sampled in various syllable-word positions. Consonants were sampled at SI (SIWI, SIWW) and SF (SFWF, SFWW) positions. For example, consonant /s/ was elicited in *sun* (SIWI) and *pencil* (SIWW) for SI and *mouse* (SFWF) and *hospital* (SFWW) for SF.

4.2.2.5 Syllable structure and word length

An adaptation of the framework or worksheet developed by Stoel-Gammon and Dunn (1985, cited by James, 1999) was used to ensure all the consonants and vowels were sampled in a variety of phonotactic shapes and word length. The framework proposed by Stoel-Gammon and Dunn (1985) is displayed in Table 4.9. The first column (C1) lists all the 24 consonants. For initial word position, consonants are elicited in several phonotactic shapes, as simple monosyllabic words such as CV (Column 2), CVC (Column 3) to polysyllabic words (Column 6). Word-initial consonant clusters in monosyllabic (Column 4) and polysyllabic (Column 7) structures are also included. Other monosyllabic words of other shapes than those described above are classified in (Column 5). Likewise, for final word position, consonants can appear in monosyllabic structures such as VC (Column 10) or CVC (Column 11) or polysyllabic word structures (Column 14). In addition to that, word-final consonant clusters in monosyllabic structures (Column 12) and polysyllabic structures (Column 15) are portrayed. Other monosyllabic words with final consonants of other shapes than those described above are arranged in (Column 13). For medial word position, there are two varieties of word structures illustrated. These include consonants that occurred at intervocalic position (Column 8) and consonant abutted to other consonants (Column 9).

Table 4.9: The Framework Proposed by Stoel-Gammon (1985)

Phonemes	Initial						Medial		Final					
1	2 CV	3 CVC	4 CCV-	5 1 Syll	6 XS	7 CCXS	8 XS	9 CCXS	10 VC	11 CVC	12 -VCC	13 1 Syll	14 XS	15 XSCC
/p/														
/b/														
etc														

Key: CCV/-VCC may, or may not have a final consonant; 1 syll = a different shape than displayed; XS = di- or polysyllabic word; CCXS/XSCC = an initial or final cluster in a di- or polysyllabic word; the cluster may have 2 or 3 constituents

Ideally, all the cells should be filled up in order to get a wide distribution of words across different phonotactic shapes and word length. Words were selected to complete as many cells in Table 4.9 as possible. However, it was not feasible to fill up all the cells due to some genuine and impractical reasons. First, some words did not exist. For example, /l/, /w/, /ð/ are not present in CCXS structure in English. Secondly, some words were difficult for young children to understand. For example, one of the words for /v/ with CCV structure was *"view"* which was too hard to be illustrated as well as perceived by children. Thirdly, some words were too complex to be illustrated in the test material. For example, some words for /θ/ in VCC structure, like *"health"*, *"depth"* and *"length"* which appeared in a noun form, were difficult to depict. Finally, some words were infrequent or unfamiliar in Malaysia culture. For example, for /ʃ/ in CCV- structure, the only word that was common to children was *"shrimp"*. However, children in Malaysia are more familiar with *"prawn"* instead of *"shrimp"*.

This framework ensures a wide coverage of phonemes and words of different length and phonotactic shapes. The use of this framework overcomes several issues highlighted by researchers concerning the validity of assessment procedures. One of the major issues is the analysis of vowels. The literature on the investigation of phonological acquisition in vowels is not extensive, either in normal or disordered children (Donegan, 2002; Gibbon, Shockey, & Reid, 1992; Pollock, 2002). In the present study, vowels will be analyzed according to one-vowel structures as in CV, VC, CVC and VCC multi-vowel structures as in CVCV, VCVC and CCVV. Young (1995) and James (1997) found that polysyllabic words are not routinely assessed during phonological assessments, which casts doubt on the validity of the results. From the findings of the survey in **Chapter 2**, three published tests that are commonly used by Malaysian SLPs are the Goldman-Fristoe Test of Articulation (Goldman, Fristoe, & Williams, 2000), the South Tyneside Assessment of Phonology (Armstrong & Ainley, 1988) and the Phonological Profile for Hearing Impaired Test (Vardi, 1991). The percentage of monosyllabic words in these tests is very high, ranging from 45.5% in Goldman-Fristoe Test of Articulation to 66.0% in the South Tyneside Assessment of Phonology and 68.5% in the Phonological Profile for Hearing Impaired Test. The percentage of polysyllabic words in these tests is very low, with less than 10% in both Goldman-Fristoe Test of Articulation and the Phonological Profile for Hearing Impaired Test. The South Tyneside Assessment of Phonology does not include any polysyllabic words. In the present framework, consonants with various word lengths, especially polysyllabic words were systematically sampled, with 115 monosyllabic words (59.0%), 48 disyllabic words (24.6%) and 32 polysyllabic words (15.4%) with 3, 4 and 5 syllables (Table 4.10).

Table 4.10: The Number of Syllables in Stimulus Words

Number of Syllables	1	2	3	4	5
Number of Occurrence / 195 Words	115	48	23	7	2
Percentage	59.0%	24.6%	11.8%	3.6%	1.0%

4.2.2.6 Syllable stress

Gleitman and Wanner (1982) pointed out that the feature *stress* plays an important role in syntactic and morphological as well as phonological development. Studies of the development of stress and rhythm indicate that young English speaking children have difficulty producing unstressed rather than stressed syllables (Allen and Hawkins, 1980). English, is a language in which the stressed syllables are perceived as being evenly spaced, thus the rhythmic pattern is based on an alternating arrangement of stressed and unstressed syllables. However, MalE was reported to have a more syllable-timed rather than stress-timed rhythm, though the final syllables of a tone unit are often somewhat lengthened (Platt, Weber & Ho, 1983). Words with different stress pattern were included to observe the changes of the children's phonology system (Table 4.11). The list of words with different stress patterns is shown in Appendix L.

Table 4.11: The Stress Pattern of Stimulus Words

Stress Pattern	Number of Syllables	No of Occurrence
S	1	115
Sw	2	44
wS	2	4
Ssw	3	4
Sws	3	6
Sww	3	4
wSs	3	3
wSw	3	5
Swsw	4	5
Swww	4	1
Swws	4	1
Swwsw	5	1
Swsww	5	1

4.2.2.7 Morphological markers

The omission of morphological markers is one of the prominent features of MalE (Baskaran, 2004). Therefore, in a study of the phonological development of children who speak MalE, they should be afforded an opportunity to produce morphological markers to facilitate a comparison with adults' speech. Morphological suffixes such as plurals and past tense markers were included in the present study to investigate whether children use morphological markers. As shown in Table 4.12, four words contained a plural marker and four words had a past tense marker.

Table 4.12: The Morphological Markers of Stimulus Words

Markers	Plurals	Past Tense
Words	dogs gloves cats chicks	jumped kicked laughed played
Number of Occurrence	4	4

4.2.2.8 Familiarity of words

Phoneme production is greatly affected by the child's familiarity with the word (Wellman, et al., 1931). This should be considered while developing culturally appropriate and familiar stimuli for Malaysian children. SLPs in Malaysia strongly felt that vocabulary should be relevant and familiar to Malaysian children. In addition, the stimulus pictures should be culturally appropriate (see Chapter 2). With this in mind, some vocabulary items, which appear in commonly cited publications or standardized tests overseas, but which are not culturally appropriate to Malaysian children were excluded from the test in the present study. These included words such as *wagon*, *shovel*, *snowman*, *chimney*, *vegemite* and *sled*. The other concern was about the differences in pronunciation across varieties of English. In Australia, words such as *strawberry* (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002) are considered as two syllable words. However, in Malaysian English, these words are produced as three syllable words. The other key aspect is the selection of vocabulary in terms of common usage. Some items appear to have more than one label. For example, *motorbike-motorcycle*, *plane-aeroplane*, *shrimp-prawn*, *zipper-zip* etc. In Malaysia, the first word in all the pairs is infrequently used. Consequently, inclusion of those inappropriate items might lead to bias in the results.

4.2.2.9 Syntactic classes of words

Nouns are extensively sampled in most of the published tests (Bankson & Bernthal, 1990; Dodd, et al., 2002; Goldman, et al., 2000). Some publications suggest including words from a range of syntactic classes, as there is some evidence that sound acquisition is later in syntactic classes other than nouns (Crystal, 1987; James, 2001; Shriberg & Kwiatkowski, 1980). Nonetheless, inclusion of syntactic classes such as verbs, adjectives, pronouns, articles and prepositions might increase the difficulty of the test items, and thus reduce spontaneous responses from children. James (2001) found that normal children showed less than 50% of spontaneous responses when naming verbs, adjectives and articles. Imitation produces fewer misarticulations in testing than spontaneous speech in school-age children (Bankson & Bernthal, 1981). Therefore, it would be better to sample words that are likely to elicit spontaneous speech responses from children. Hence, nouns were extensively sampled in this study compared to words from other syntactical classes.

The final form of the test material consisted 195 words (Appendix M), consisting mainly of nouns (about 90%). Almost 10% of the words were from other syntactic classes such as verbs, adjectives, pronouns, determiners and prepositions. The inclusion of words from other syntactic classes was due to practical reasons. There were ten verbs in the sample. Three verbs were selected to elicit initial consonant clusters, as these words were considered more familiar to children as compared to other words. For example, *splash /spl/, spray /spr/* and *twinkle /tw/*. *Singing* was chosen to target the /ŋ/ sound at medial word position. Another three verbs *eat*, *row* and *go* were included to elicit consonant /t/ at VC structures (*eat*) and /r/ and /g/ at CV structure (*row* and *go* respectively). Due to the need for children to produce morphological markers, verbs with past tense markers such as *kicked, jumped, played* and *laughed* were included. There were two adjectives included, which were *low* and *new*. The word *low* was selected to represent consonant /l/ in CV structure and *new* was targeted for initial consonant cluster /nj/. There were two deictics in the sample. Two words *there* and *this*, were used to elicit consonant /ð/ in initial word position. As a result of limited choices of words to elicit VC structures for most of the consonants, prepositions such as *on* and *up* were regarded as appropriate words to be included in the sample. The word *behind* was chosen as to elicit final cluster /nd/ at XSCC structure. Lastly, one pronoun *nothing* was included to elicit consonant /θ/ in SIWI. The number of tokens within each syntactic class is recorded in Table 4.13.

Table 4.13: The Syntactic Classes of Stimulus Words

Syntactic Classes	Nouns	Verbs	Adjectives	Deictics	Pronoun	Prepositions
Words	all except those stated	splash spray twinkle singing eat row go kicked jumped laughed played	low new	there this	nothing	on up behind
Number of Occurrence	176	11	2	2	1	3
Percentage of Occurrence	90.26	5.64	1.03	1.03	0.51	1.54

Summary

Overall, all the variables discussed above were considered in the development of the stimuli in present study. Although they were described independently according to different criteria, in fact they interacted closely. Usually, more than one of these criteria would be considered simultaneously while selecting the target word. For example, the word *aeroplane* /ɛroplen/ was sampled while considering its phonetic inventory (vowel, consonants and consonant cluster), syllable position (syllable initial /r/ and cluster /pl/, syllable final /n/), word length (3 syllable words), word stress (Sws), word familiarity (*aeroplane* instead of *plane*) and syntactic class (noun). In sum, the selection of words for the stimuli was influenced by all of these criteria as a whole, and the ultimate goal of these stimuli was to elicit a representative speech sample from children via single word naming.

4.2.3 Presentation of Stimuli

In this study, words were selected from numerous sources, including published test (Bankson & Bernthal, 1990; Dodd, et al., 2002; Goldman, et al., 2000), a sourcebook (Worthley, 1981) and journal articles (James, 1997; James, 2001; Klein, 1981; McLeod, 1997; Young, 1991). Once these words were determined, they were then illustrated and compiled into a test booklet.

One of the practical factors in developing stimulus materials is the attractiveness, compactness and manipulability of materials. Size, familiarity and colour of stimulus pictures and appropriateness for the children may influence the ease with which the clinician obtains responses to test stimuli. Due to the large number of words in the test, it was impractical to ask children, especially those as young as three or four years old to name individual pictures. With the purpose of making the test interesting and attractive to children, composite pictures were used. The items were illustrated and presented colourfully in composite pictures according to themes.

The utilization of thematic information in the composite pictures was judged to be a more effective means to elicit targeted responses compared to single word picture naming. In Goldman and Fristoe (2000), there are several items in the test, which are grouped into themes. For example, *house-window-tree, cup-knife-spoon, duck-quack-yellow, rabbit-carrot-orange, ring-finger-thumb, clown-balloons* etc. Similarly, stimuli pictures are arranged according to semantic category, for example animals and vehicles, in Smit et al.'s (1990) study in order to increase the probability of children identifying the pictures spontaneously. Thematic information is one form of general knowledge that children must learn about. Markman (1989) made the important point that it is necessary for children to know thematic relations. A child learns that presents, cake, candles and guests are all likely to be found in a birthday party. Waxman and Namy (1997) showed that 3 years old are likely to respond thematically to the question "Which goes with" the target item (about 50% of the time) in their study. Thus, it is expected that children will exhibit better word retrieval or naming ability while associating items, which appear in a theme or situation as in composite picture. In addition, some abstract words such as "nothing", "on", "off" are easily elicited in a context in contrast with single picture.

Therefore, 30 composite pictures with a size of 30 cm x 21 cm were illustrated. The items were placed together by themes, ranging from 3 to 11 words in each picture. The average number of words targeted in each composite picture was 6. For example, items such as *orange-banana-papaya-strawberry-pear-watermelon* were grouped together in a category of fruits in one stimulus picture in the present study (Appendix N).

4.3 ASSESSMENT PROCEDURES

4.3.1 The Assessor

The author of the present thesis assessed all 264 children. The author is a qualified speech-language pathologist in Malaysia, with 4 years clinical experience. The author is familiar with elicitation techniques and is skilful in phonetic transcription.

4.3.2 Equipment

An important methodological consideration for any investigation of child speech is the recording of the data obtained. In the present study, the participants' speech samples were audio-recorded in order to facilitate transcription and inter-judge reliability checking. The recording was done according to the important recording considerations outlined by Shriberg and Kwiatkowski (1980). These included use of an external microphone placed 6-12 inches from the child's mouth for a good signal-to-noise ratio and a high-quality audio recorder (recording system in Laptop Inspiron 640m) and microphone (Sony ECM-PC50) that records a wide range of frequencies (100-15,000 Hz) for speech. Participants' speech was recorded in wav format.

4.3.3 Testing Procedures

4.3.3.1 Testing Environment

Each child was seen individually either at kindergartens, child-care centres, nurseries, schools or the child's home. The author established rapport with the child prior to testing. The test was administered in a quiet, well-lit room that contained a table or desk and two chairs of appropriate heights. The author and child were seated across the corner of a table or on opposite sides. The stimulus book was clearly visible to both, with the picture plate facing the child and the text facing the assessor. The child was briefed on the reinforcement system prior to the testing. The child needed to complete a 30-step board game, where he/she was allowed to move a step upon the completion of naming one composite picture. Once he completed the board game, he/she was given a sticker as a reward.

4.3.3.2 Recording and Transcribing the Speech Samples

The author did not transcribe the child's responses on site due to time constraints. As the author needed to elicit large number of stimulus words, a longer time for transcription was required. In addition, the participants would have lost their focus if they were asked to attend to the task for too long. Therefore, the assessment process was audio-recorded to enable the transcription after the assessment session. It was also used for reliability sampling. During the testing, the author had to keep an unobstructed view of the child to both hear the child's articulation clearly.

4.3.3.3 Recording Identifying Information

Before beginning the testing, the author filled in the identifying information about the child on the front of the response form (Appendix O). The author filled in the child's pseudonym and gender. Later, the author verified the birth date of the child so as to calculate the chronological age. Then, other details such as the name of the child's school and the form teacher were filled in.

4.3.3.4 Administering the test

Before administering the test, the testing environment was set up as indicated in 4.3.3.1. Then the following administration processes were carried out:

1. The author placed the stimulus book in front of the child. Then, the author read the instructions to the child in a natural, conversational style before the first picture plate was shown. The instruction was "You are going to see some pictures here. I will turn the pages, and I want you to tell me about the pictures." As the assessor turned the page, the first picture plate faced the child, while the targeted responses, stimulus questions and cuing strategies for plate 1 were on the page facing the author.
2. Then, the author pointed to the item in the plate and asked "What is this?" The question "What is this?" was used with the majority of the pictures to elicit the target word. However, some stimulus questions necessarily differed to get the desired responses for a picture, for example, "What sound does a pig make?"; "Who is this?"; "What colour is this?" etc. The goal of the test was to elicit the desired sounds and words spontaneously. However, if the child did not give the expected reply, the author would use the prompts and cues provided on the author's pages. The prompting system is described in the section 4.3.3.5.
3. After the author recorded the child's performance on the response form from the first plate, she turned the page so the next picture plate was facing the child. The author asked the subsequent stimulus questions. The author continued in this same way until all 30 pictures plates were presented and all 195 target words were elicited.

4.3.3.5 Prompting

During the testing, the author provided positive feedback to encourage children to cooperate. Children were encouraged to name as many pictures as possible. Spontaneous naming was encouraged at all times while the author pointed to the item in the composite pictures. Sometimes, if the target word was a specific part of the picture (e.g., flower in the hat in *Plate 21*), the author pointed to the particular item (flower) as she asked the stimulus question. Pointing was also used as a way to draw a child's attention back to the task. In this way, pointing could be used as a general prompt to redirect the child's attention and also to elicit a target word. The author could vary the stimulus text slightly from what was given on the author's page if the author felt that, for a particular child, a slightly different wording of the question would be a more natural and relaxed cue. Many publications (Bankson & Bernthal, 1990; Goldman, et al., 2000) indicate that some target words often need prompts in addition to the stimulus question. For example, some children say *TV* for *television* or *hippo* for *hippopotamus.* Therefore, the author prompted by saying "Yes, but what else can you call it?" or "Yes, but what is the long name for it?" These prompts were used whenever the child had given a correct label for the picture but not the intended target word. When the author misheard a child response, the author asked the child to repeat a response by saying "I missed that. Please say it again." The ideal response from children is spontaneous naming without prompting, because spontaneous speech is more representative of children's habitual speech than prompted words (Bankson & Bernthal, 1996). Nonetheless, because this test was aiming at collecting phonological sample, appropriate cues were used to elicit test items. If children required assistance, they were given cues in the following hierarchy.

I) Semantic cue or description of the word (e.g., "It is something you can sit on")

II) Binary or forced choices with the target word first (e.g., "Is it a <u>chair</u> or a bed?"); the other word choice given *("bed")* contained the same number of syllables as the target response, but with differ phonemic features, preferably from same semantic category.

III) Delayed imitation of the word (e.g., "It's a <u>chair</u>. What is it?").

IV) Immediate imitation of the word (e.g., "Please say "chair").

Following the administration of the test, author analyzed the data and entered scores on the record forms for each individual assessment.

4.4 DATA REDUCTION AND ANALYSES

4.4.1 Transcription

Auditory analysis was employed in the present study. All the speech data gained were transcribed phonetically using earphones and analyzed descriptively. The speech was initially transcribed according to a broad phonetic transcription. A narrow phonetic transcription was used when phoneme production was judged to differ from normal tolerances. For instance, dentalization or lateralization diacritics were used when /s/ was perceived as dentalized or lateralized. Dialectal variations were accepted as correct. The auditory decision for the dialectal variations was derived from the findings in Chapter 3 and is shown in Appendix P.

4.4.2 Reliability

In order to establish inter-judge reliability, the speech was independently analyzed by the author and a trained phonetician. A total of 5.3% of the data were independently transcribed for the purpose of inter-judge reliability. The inter-judge point-to-point agreement for all phonemes was 92.69%, ranging from 87.50% to 95.83% for individual children with a standard deviation of 2.94. All differences were resolved through agreement.

4.4.3 Analyses

The speech which contained 195 targeted words was segmented and labelled using *Transcriber* (Boudahmane, Manta, Antoine, Galliano, & Barras, 1998) and then transcribed phonetically before being entered into the *Prophecy* component of *Computerized Profiling (version 9.0)* and analyzed using the *PROPH+* component of *Computerized Profiling* (Long & Fey, 1996). The transcription file created by *PROPH+* for each child was further separated into three subfiles based on the number of syllables in the words in order to proceed with the analysis of speech sound accuracy according to syllable types. Thus, there was one file for the MSWs with 115 words, another for the DSWs with 48 words and another for the PSWs with 32 words. The *PROPH+* analysis was conducted on each of these subfiles. All generated data were compiled and sorted using a specially written computer program. The specific procedures for analysis of each result are described in the result chapters, **Chapter 5 to 7**. The following procedures were common to all analyses. The method of elicitation was not considered in any of the analyses. That is, whether the word was said spontaneously or with a prompt, it was included in the analysis. *PROPH+* eliminates from its word analysis where there is a mismatch in the number of syllables to the target words. This means that words where children either added or deleted syllables were omitted from the analysis. In order to capture these changes, the author manually examined all data for the presence of each of the patterns. Words with no responses from children were considered as an error in the present study. All statistical analyses were conducted using *SPSS for Windows (*Apache Software Foundation, 2000).

4.4.4 Analysis of Stimuli Responses

Although no allowances were made for the method of elicitation in the analyses of the present study, it is important to know the different types of naming responses shown by the children, for instance, spontaneous naming versus imitation naming. This is because many researchers claim that imitated speech resembles more adult-like productions than spontaneous speech. Thus, imitated speech overestimates children' phonological ability (Goldstein, Fabiano, & Iglesias, 2004; Shea & Blodgett, 1994). Hence, the proportion of spontaneous naming in the samples will reflect the amount of children' habitual speech.

Children' responses to the 195 stimulus words were analyzed. Table 4.14 shows the proportion of different types of naming responses across ten age groups. Three main types of naming responses were demonstrated: i) spontaneous naming, ii) naming with prompting cues such as semantic cues, binary choices, delayed imitation, immediate imitation and iii) no responses. Spontaneous naming was the most commonly exhibited response across all the age groups except the two youngest groups where the occurrence of naming with binary choices was higher than spontaneous naming. The occurrence of spontaneous naming increased as age increased, while the other types of naming responses reduced when the occurrence of spontaneous naming increased. A ceiling effect (between 83.6-86.4%) was noted for older children aged between 6;06 to 7;11. For naming with prompting, naming with binary choices occurred most frequently, followed by direct imitation. Delayed imitation and semantic cues occurred the least.

As a sum, the speech samples elicited from older children will be more representative than those from younger children. Older children demonstrated approximately spontaneous naming for approximately 80% of the words where younger children spontaneously named less than 50% the words. In addition, the results revealed that children's spontaneous naming responses plateau after 6 years old.

Table 4.14: Different Types of Naming Responses across Age Groups

Age Group	Gender	Number (n)	Mean Age (year; month)	SD (month)	Responses (n) and (%) Out of 195 Words											
					Spontaneous		Prompting								No Response	
							Semantic Cue		Binary Choices		Delayed Imitation		Immediate Imitation			
					n	%	n	%	n	%	n	%	n	%	n	%
3;00-3;05	F	8	3;01	1.7	91.6	47.0	6.1	3.1	63.1	32.4	18.1	9.3	14.5	7.4	1.5	0.8
	M	7	3;02	2.1	89.1	45.7	5.9	3.0	65.0	33.3	19.7	10.1	13.3	6.8	2.0	1.0
	Total	**15**	**3;02**	**1.9**	**90.4**	46.3	**6.0**	3.1	**64.1**	32.8	**18.9**	9.7	**13.9**	7.1	**1.8**	0.9
3;06-3;11	F	16	3;10	1.1	109.1	55.9	6.7	3.4	61.4	31.5	4.7	2.4	12.4	6.4	0.7	0.4
	M	10	3;09	1.5	114.3	58.6	5.3	2.7	55.2	28.3	6.6	3.4	13.0	6.7	0.6	0.3
	Total	**26**	**3;10**	**1.3**	**111.7**	57.3	**6.0**	3.1	**58.3**	29.9	**5.7**	2.9	**12.7**	6.5	**0.7**	0.3
4;00-4;05	F	14	4;03	1.5	125.6	64.4	5.2	2.7	51.6	26.5	2.5	1.3	9.7	5.0	0.3	0.2
	M	15	4;02	1.6	118.7	60.9	5.1	2.6	55.7	28.6	4.9	2.5	10.4	5.3	0.2	0.1
	Total	**29**	**4;03**	**1.6**	**122.2**	62.6	**5.2**	2.6	**53.7**	27.5	**3.7**	1.9	**10.1**	5.2	**0.3**	0.1
4;06-4;11	F	15	4;09	1.5	128.2	65.7	6.9	3.5	49.5	25.4	1.8	0.9	8.5	4.4	0.1	0.1
	M	15	4;08	1.7	118.7	60.9	5.9	3.0	55.5	28.5	2.2	1.1	12.5	6.4	0.3	0.2
	Total	**30**	**4;09**	**1.6**	**123.5**	63.3	**6.4**	3.3	**52.5**	26.9	**2.0**	1.0	**10.5**	5.4	**0.2**	0.1
5;00-5;05	F	15	5;02	1.4	136.5	70.0	5.9	3.0	44.5	22.8	2.5	1.3	5.5	2.8	0.1	0.1
	M	15	5;02	1.5	140.4	72.0	7.3	3.7	40.1	20.6	0.7	0.4	6.4	3.3	0.1	0.1
	Total	**30**	**5;02**	**1.5**	**138.5**	71.0	**6.6**	3.4	**42.3**	21.7	**1.6**	0.8	**6.0**	3.1	**0.1**	0.1
5;06-5;11	F	15	5;08	1.3	141.7	72.7	7.1	3.6	39.4	20.2	0.7	0.4	6.1	3.1	0.1	0.1
	M	15	5;08	1.4	147.1	75.4	5.9	3.0	34.7	17.8	1.6	0.8	5.5	2.8	0.1	0.1
	Total	**30**	**5;08**	**1.4**	**144.4**	74.1	**6.5**	3.3	**37.1**	19.0	**1.2**	0.6	**5.8**	3.0	**0.1**	0.1
6;00-6;05	F	16	6;03	1.4	149.9	76.9	5.6	2.9	32.1	16.5	1.1	0.6	6.0	3.1	0.3	0.2
	M	15	6;02	1.4	149.1	76.5	6.1	3.1	33.1	17.0	1.1	0.6	5.5	2.8	0.1	0.1
	Total	**31**	**6;03**	**1.4**	**149.5**	76.7	**5.9**	3.0	**32.6**	16.7	**1.1**	0.6	**5.8**	2.9	**0.2**	0.1
6;06-6;11	F	9	6;08	2.0	163.0	83.6	6.2	3.2	21.6	11.1	0.6	0.3	3.7	1.9	0.0	0.0
	M	4	6;08	1.5	174.0	89.2	2.3	1.2	15.3	7.8	0.5	0.3	3.0	1.5	0.0	0.0
	Total	**13**	**6;08**	**1.8**	**168.5**	86.4	**4.3**	2.2	**18.5**	9.5	**0.6**	0.3	**3.4**	1.7	**0.0**	0.0
7;00-7;05	F	15	7;03	1.6	165.2	84.7	4.3	2.2	21.3	10.9	0.7	0.4	3.5	1.8	0.1	0.1
	M	15	7;02	1.4	163.2	83.7	4.7	2.4	22.8	11.7	0.3	0.2	3.9	2.0	0.2	0.1
	Total	**30**	**7;03**	**1.5**	**164.2**	84.2	**4.5**	2.3	**22.1**	11.3	**0.5**	0.3	**3.7**	1.9	**0.2**	0.1
7;06-7;11	F	16	7;07	1.0	165.4	84.8	3.2	1.6	22.5	11.5	0.2	0.1	3.6	1.8	0.1	0.1
	M	14	7;07	1.1	160.6	82.4	4.7	2.4	25.1	12.9	0.2	0.1	4.1	2.1	0.3	0.2
	Total	**30**	**7;07**	**1.1**	**163.0**	83.6	**4.0**	2.0	**23.8**	12.2	**0.2**	0.1	**3.9**	2.0	**0.2**	0.1

CHAPTER 5
AGE OF SPEECH SOUND ACQUISITION

5.0 INTRODUCTION

The focus of this chapter is to present norms for the order and age of speech sound acquisition of typically developing MalE speaking children. The specific aims of this analysis were:

1. To determine the age of customary production and mastery production of
   i) different MalE consonants in syllable initial (SI) and final (SF) positions;
   ii) MalE vowels;
   iii) MalE consonant clusters in SI and SF.
2. To compare the age of speech sound acquisition in MalE with Standard English (SE).

The method of calculating the age of speech sound acquisition will be described, followed by description of the results and discussion.

5.1 METHODS

In accounts of the age of speech sound acquisition in normative studies, the degree of production accuracy, and the percentage of children in an age group who reached that level of accuracy in phoneme production, should be included (Dodd, Holm, Hua, & Crosbie, 2003; Goldman, Fristoe, & Williams, 2000; Mowrer & Burger, 1991). In a phonemic approach, the differences between children' realizations and adults' target forms are usually described. The dialectal variations of MalE (Chapter 3) were therefore considered when evaluating the age of speech sound acquisition of MalE speaking children. For example, /v/ is likely to be substituted with [w] in MalE, so /v/ will be considered as acquired if it was produced as [w]. Similarly, the speech sound realizations usually used for the dental fricatives were accepted. This results in some MalE sounds being apparently acquired earlier than parallel SE sounds because MalE speaking children are actually acquiring simple realizations. These phonemes are bolded in the tables in this chapter to indicate that the significant MalE variants have been taken into consideration.

In the present study, age of consonant and consonant cluster acquisition was calculated according to syllable position (SI and SF) by averaging the percentage of children who produced the sound correctly at least twice in the relevant syllable-word positions. SI refers to both syllable-initial word-initial (SIWI) and syllable-initial within-word (SIWW) while SF refers to syllable-final word-final (SFWF) and syllable-final within-word (SFWW). For example, age of acquisition for the /b/ sound in SI was calculated based on the average of SIWI and SIWW with the sound having to occur at least twice in each syllable-word position. However, when there was only one opportunity for the sound to occur, (e.g. /j/ sound at SIWW), the criteria included just one opportunity of occurrence. Ages of consonant cluster acquisition which were reported according to category were calculated based on the average of the percentage of children who produced the consonant cluster correctly at least twice in each consonant cluster. Age of speech sound acquisition for consonant, vowel and consonant clusters was established according to age of customary production and age of mastery production. For this study, **age of customary production** is defined as follows: a sound was considered to have emerged when 50% of the children in an age group produced the sound correctly at least twice in two consecutive age groups. **Age of mastery production** is defined as follows: a sound was considered to be mastered when 90% of the children in an age group produced the sound correctly at least twice in two consecutive age groups. This study adopted a 90% criterion in determining age of mastery or acquisition because the prevalence for phonologically delayed and disordered children is reported to be about 10% of the normal population (National Institute on Deafness and Other Communication Disorders, 1994). The rationale for the criterion 'the sound to occur at least twice in two consecutive age groups' was to ensure the stability of performance in terms of sound production and number of participants.

The age of speech sound acquisition of MalE was then compared with SE. Studies of SE which contained raw data were chosen for comparison in order to preclude discrepancies caused by different criteria being used in determining the age of acquisition. Thus, the same criteria were used across all studies to facilitate the comparison. First, the age of acquisition in the SE studies chosen was derived based on at least 90% of the children in an age group producing the consonant correctly in two consecutive age groups. Second, the comparison of age of consonant and consonant cluster acquisition was done according to syllable position (SI and SF) instead of the classical way of averaging three word positions (initial, medial and final) as discussed in Chapter 1.

5.2 RESULTS

5.2.1 Age of MalE Consonant Acquisition

The age of customary production and mastery production of MalE consonants according to syllable position, SI and SF, are shown in Table 5.1 and Table 5.2 respectively. For age of customary production, all consonants in SI emerged at age 3;00-3;05 years except /ŋ/ and /ʒ/ (in ambisyllabic position) which emerged at age 4;00-4;05 years. In other words, all consonants in SI emerged no later than 4;05 years old. As for consonants in SF, all consonants also emerged at age 3;00-3;05 years, with the exception for /θ/ and /tʃ/ which emerged at age 3;06-3;11 years and /dʒ/ at age 4;00-4;05 years. The only consonant that did not meet the criteria of emerging was /v/ even in the oldest age group. For age of mastery in SI, 13 consonants were mastered at age 3;00-3;05 years comprising of all stops, nasals (except /ŋ/), liquids and two fricatives (/f/ and /s/). Other fricatives like /v/, /ð/ and /ʃ/, /h/ were mastered soon after, between the age of 3;06-3;11 and 4;00-4;05 years respectively. The consonants /ʒ/ and /θ/ were mastered at age 5;06-5;11 and 6;06-6;11 respectively. The /z/ sound appeared to be a difficult consonant as mastery was not exhibited even in the oldest age group in the present study. Affricates were mastered between 3;06-4;05 years, while glides were mastered at age 4;00-4;11 years. As for age of mastery in SF, 11 consonants (/t/, /d/, /k/, /g/, /m/, /ŋ/, /z/, /l/, /n/, /f/ and /s/) were mastered before the age of 4;06 and seven consonants were mastered after age 7;00 (/b/, /ʃ/, /p/, /θ/, /tʃ/ /dʒ/ and /v/).

Table 5.1: Age of Customary Production of MalE Consonants Taking MalE Dialectal Features into Consideration

Age Group	Syllable Initial (SI)		Syllable Final (SF)	
3;00-3;05	Stop Nasal Fricative Affricate Glide Liquid	**p, b, t, d, k, g** m, n f, **v, θ, ð**, s, z, ʃ, h tʃ, dʒ w, j l, r	Stop Nasal Fricative Liquid	**p, b, t, d, k, g** m, n, ŋ f, s, **z**, ʃ **l**
3;06-3;11			Fricative Affricate	**θ** tʃ
4;00-4;05	Nasal Fricative	ŋ ʒ	Affricate	**dʒ**
> 8			Fricative	**v**

Notes:
- SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
- SF refers to SFWF (syllable-final word-final) and SFWW (syllable-final within-word)
- /ʒ/ and /ŋ/ in SI refer only to words assessed in ambisyllabic position like *treasure* for /ʒ/ and *singing* for /ŋ/.
- Consonants in **bold** are consonants produced with significant variants which are acceptable in MalE.

Table 5.2: Age of Mastery Production of MalE Consonants Taking MalE Dialectal Features into Consideration

Age Group	Syllable Initial (SI)		Syllable Final (SF)	
3;00-3;05	Stop Nasal Fricative Liquid	**p, b, t, d, k, g** m, n f, s l, r	Stop Nasal Fricative Liquid	**t, d, k, g** m, ŋ **z** **l**
3;06-3;11	Fricative Affricate	**v** dʒ	Nasal	n
4;00-4;05	Fricative Affricate Glide	**ð**, ʃ, h tʃ j	Fricative	f, s
4;06-4;11	Glide	w		
5;06-5;11	Fricative	**ʒ**		
6;06-6;11	Fricative	**θ**		
7;00-7;05			Stop	**b**
7;06-7;11	Nasal	ŋ	Fricative	ʃ
> 8	Fricative	z	Stop Fricative Affricate	**p** **θ, v** tʃ, **dʒ**

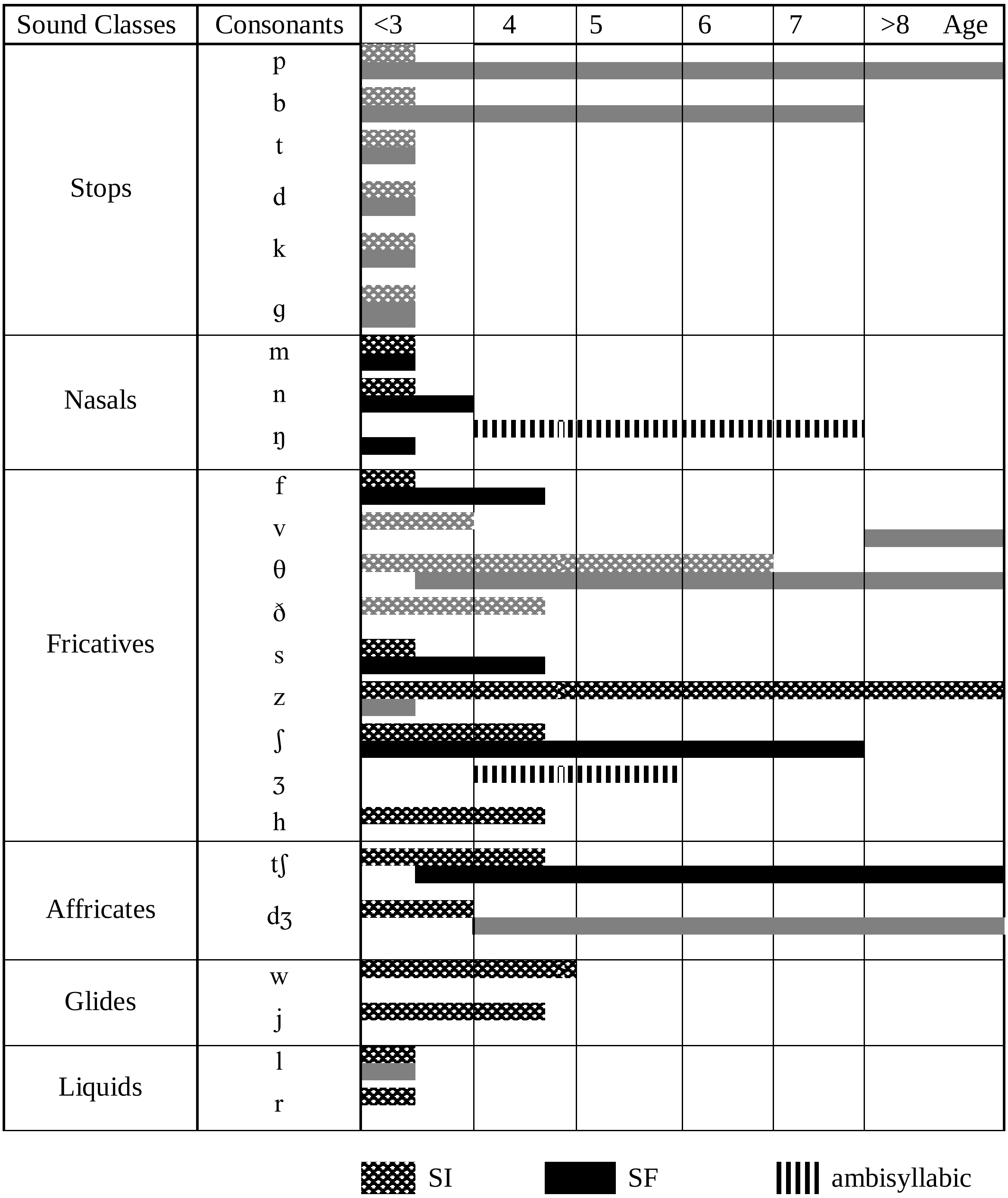
Notes:
- SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
- SF refers to SFWF (syllable-final word-final) and SFWW (syllable-final within-word)
- /ʒ/ and /ŋ/ in SI refer only to words assessed in ambisyllabic position like *treasure* for /ʒ/ and *singing* for /ŋ/.
- Consonants in **bold** are consonants produced with significant variants which are acceptable in MalE

5.2.2 Age of MalE Consonant Acquisition in SI and SF

The ages of phonemic acquisition of MalE consonants, considering the syllable position and articulatory features, are portrayed in Figure 5.1. This graphic presentation facilitates the comparison of age of acquisition for consonants in SI and SF. The solid bar corresponding to each sound begins at the median age of customary production and ends at the age of mastery production. The /v/ sound is highlighted in grey to indicate that it did not meet the criteria for age of customary production until 7 years old. From Figure 5.1, it is obvious that many consonants in SI and SF were mastered at different age levels. A comparison of age of consonant acquisition in SI and SF was carried out based on the sequence of sound classes: stops, nasals, fricatives, affricates and liquids. Most stops were mastered at the same age except bilabial stops. The mastery of /b/ in SF was only completed by age 7;00-7;05 years and /p/ in SF was not mastered even by age of 7;06-7;11 years. As for nasals, /m/ was mastered similarly in both SI and SF, /n/ in SF was mastered half a year later than in SI, while for /ŋ/, there was a big gap between the mastery in SF (3;00-3;05) compared to SI (7;06-7;11). Apart from /ð/, /ʒ/ (in SIWW) and /h/ which were assessed only in SI, other fricatives exhibited different ages of mastery in SI and SF. All fricatives were mastered earlier in SI compared to SF, except /z/, which was mastered earlier in SF. Affricates showed a similar mastery trend as fricatives, where affricates in SF were mastered much later than in SI. The mastery of affricates was not complete even at the age of 7;06-7;11 years. Liquids were mastered concurrently in both SI and SF.

In sum, the majority of MalE consonants differed in terms of age of mastery production according to syllable position. Out of the 18 consonants assessed in pairs in SI and SF, six pairs were mastered at the same age while 12 pairs differed in the rate of mastery. The consonants in SI and SF which were not mastered at the same age were usually mastered first in SI compared to SF, with the exceptional to /ŋ/ and /z/, which were acquired first in SF. These results highlight the importance of considering SI and SF separately rather than averaging results across all positions.

Figure 5.1: Age of MalE Consonant Acquisition in SI and SF Taking MalE Dialectal Features into Consideration



Notes:
- Graphic presentation was adapted from Sander (1972).
- The solid bar corresponding to each sound begins at the median age of customary production and ends at an age of mastery.
- SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
- SF refers to SFWF (syllable-final word-final) and SFWW (syllable-final within-word)
- /ʒ/ and /ŋ/ refer only to words assessed in ambisyllabic position like *treasure* for /ʒ/ and *singing* for /ŋ/.
- The bars in grey indicate phonemes produced with significant variants which are acceptable in MalE.

5.2.3 Comparison of Age of Consonant Acquisition in MalE and SE

The age of MalE consonant acquisition in the present study was compared with several past studies of SE (Goldman, et al., 2000; Smit, Hand, Bernthal, Freilinger, & Bird, 1990; Templin, 1957; Wellman, Case, Mengert, & Bradbury, 1931). When the new set of criteria (90% acquisition level according to syllable position) was used across all studies, many of the SE consonants were acquired later than reported in the original studies. For example, Templin (1957) reported that /s/ was acquired by age 4 years with the method of averaging the percentages from the three word positions and mastery criterion at 75% level. However, when acquisition of /s/ in Templin's (1957) study was analyzed according to different syllable positions and the mastery criterion at 90% level, /s/ was acquired by age 7 years in SI and 8 years in SF.

Table 5.3 compares the age of acquisition of 24 consonants in SI position. Variations were observed among the studies of SE. Therefore, it is difficult to compare the age of consonant acquisition based on discrete age levels in such circumstances. So, comparisons were made according to general commonalities. On the whole, 12 MalE consonants in SI (/f/, /v/, /θ/, /ð/, /s/, /ʃ/, /ʒ/, /tʃ/, /dʒ/, /j/, /l/ and /r/) appeared to be acquired earlier than in SE, nine MalE consonants showed similar acquisition trends (/p/, /b/, /t/, /d/, /k/, /g/, /m/, /n/ and /z/) as in SE and three MalE consonants (/ŋ/, /h/ and /w/) were acquired far later than in SE. As for the age of acquisition in SF (Table 5.4), 17 consonants were compared. In general, seven MalE consonants were acquired earlier (/t/, /d/, /g/, /ŋ/, /s/, /z/ and /l/). Six MalE consonants (/k/, /m/, /n/, /f/, /v/, /θ/ and /ʃ/) demonstrated analogous age of acquisition with SE. Four MalE consonants (/p/, /b/, /tʃ/ and /dʒ/) were acquired later than in SE. Overall, the age of acquisition of MalE was not identical to SE. More MalE consonants were acquired earlier than SE or at the same age as SE in both SI and SF, with a few consonants acquired later than SE. It must be emphasized that MalE dialectal features are taken into consideration for all the ages indicated here. Children acquiring /l/ in SF, for example, were scored correct if they vocalized the sound.

Table 5.3: Comparison of the Age of Consonant Acquisition in SI in MalE and SE

	3;0	3;6	4;0	4;6	5;0	5;6	6;0	6;6	7;0	7;6	8;0	>6	>7	>8
p	T S G ♦				W									
b	T W S G ♦													
t	S ♦	G			W		T							
d	S ♦	T		G	W									
k	T ♦	S	G		W									
g	T ♦	S	G		W									
m	T W S G ♦													
n	T W S G ♦													
ŋ			G W				T			♦				
f	♦	S	T W	G										
v		♦				S			G	T		W		
θ								♦	S	T		W		G
ð			♦			S			G		T	W		
s	♦								T G		S	W		
z									T G		S	W	♦	
ʃ			♦				W G		T S					
ʒ						♦						W		T
h	T S G		♦	W										
tʃ			♦				W S G		T					
dʒ		♦			G	S	T					W		
w	T S G		W	♦										
j			♦		S G	W	T							
l	♦				W	S G	T							
r	♦						W T G				S			

W- Wellman et al. (1931) T - Templin (1957) S - Smit et al. (1990) G - Goldman et al. (2000) ♦ - Present Study

Table 5.4: Comparison of the Age of Consonant Acquisition in SF in MalE and SE

	3;0	3;6	4;0	4;6	5;0	5;6	6;0	6;6	7;0	7;6	>6	>7	>8
p	S G		T				W					♦	
b	S G		W				T		♦				
t	♦	G	S						T		W		
d	♦	S	G		W		T						
k	S ♦		G		W		T						
g	♦		S G		W		T						
m	T S G ♦		W										
n	T G	S ♦	W										
ŋ	♦				G		T				W		S
f			T W ♦	G		S							
v					G	S					W	♦	T
θ									T S		W	♦	G
s			♦						G		W		T S
z	♦										W		T S G
ʃ							W	G	T S	♦			
tʃ					W		S G		T			♦	
dʒ							W G		S			♦	T
l	♦						T G		S				W

W- Wellman et al. (1931)
T - Templin (1957)
S - Smit et al. (1990)
G – Goldman et al. (2000)
♦ - Present Study

5.2.4 Age of MalE Vowel Acquisition

The 22 MalE vowels emerged at the age of 3 years. All vowels were mastered at age 3, except the monophthong /ʊ/ and the diphthong /ɪə/, which were respectively mastered at 3½ years old and 5½ years old (Table 5.5).

Table 5.5: Age of Mastery Production of MalE Vowels Taking MalE Dialectal Features into Consideration

Age Group	Series	Vowels
3;00-3;05	Back	**u** **ɔ** **ɒ**
	Front	**i** ɪ ɛ æ
	Central	**a** ʌ ɜ ə
	Diphthongs	aɪ aʊ **eɪ** oɪ **ɛə** **əʊ**
	Triphthongs	**aɪə**
3;06-4;00	Back	ʊ
5;06-6;00	Diphthongs	ɪə

- Vowels in **bold** are vowels produced with significant variants which are acceptable in MalE.

5.2.5 Comparison of Age of Vowel Acquisition in MalE and SE

The age of MalE vowel acquisition in the present study was compared with two previous studies of SE (Wellman et al., 1931; Templin, 1957). Table 5.6 compares the age of acquisition of 21 vowels which consisted of monophthongs, diphthongs and triphthongs. Variations were observed between the studies of SE, with Wellman et al. (1931) consistently demonstrating later ages of vowel acquisition. A comparison of vowel acquisition in MalE and SE was made according to the general commonalities instead of specific age levels due to variations in the findings across studies. Wellman et al. (1931) and Templin (1957) did not sample the same vowels that were targeted in the present study, only sampling 16 vowels. Therefore, comparisons could not be made for some vowels such as /ɪə/ and /ɛə/. As a whole, MalE vowels showed similar patterns of acquisition as Templin (1957), with two MalE vowels, /ɔ/ and /ə/ acquired much earlier. Both vowels were acquired at age 3 years in MalE, but age 6 years in Templin (1957). In Wellman et al. (1931), /ɔ/ and /ə/ were correspondingly acquired at age 5 and 2 years. Based on both Wellman et al. (1931) and Templin (1957), /ɔ/ was acquired relatively late, but acquisition of /ə/ varied.

Table 5.6: Comparison of the Age of Vowel Acquisition in MalE and SE

Vowels	<3	3;0	3;6	4;0	4;6	5;0	5;6	6;0	>7
u	W	T ♦							
ʊ		T	♦						W
ɔ		♦				W		T	
ɒ		T ♦							
i		T ♦		W					
ɪ		T ♦							W
ɛ		T ♦							W
æ		T ♦							W
a		♦	W						
ʌ		T ♦				W			
ɜ		T ♦							
ə	W	♦						T	
aɪ		♦							W
oɪ		T ♦							W
aʊ		T ♦							W
eɪ		T ♦				W			
ɪə							♦		
ɛə		♦							
əʊ		W T ♦							
ju				T					W
aɪə		♦							

W - Wellman et al. (1931) T - Templin (1957) ♦ - Present Study

5.2.6 Age of MalE Consonant Cluster Acquisition

The age of consonant cluster acquisition was evaluated according to category instead of according to individual clusters for practical reasons. This is because children appear to generalize therapy gains within the same categories of consonant clusters (McReynolds & Elbert, 1981b). Consonant clusters have been categorized according to their constituent phones (e.g. /l/-clusters, /s/-clusters or C + /l/ clusters, /s/ + C clusters), features within the cluster (e.g. nasal + glide, stop + liquid), word and syllable position of the cluster (syllable-initial, syllable-final) and the number of constituents (two or three-element clusters) (Mcleod, van Doorn, & Reed, 1997). There is no standard set of core categories for classifying consonant clusters. In the present study, consonant clusters were divided into two syllable positions: SI and SF. Initial consonant clusters were further divided into two and three elements. Consonant clusters were also categorized using a mixed system according to their constituent phones (Powell, 1994) and features within the cluster (Greenlee, 1974), as neither of these systems described consonant clusters sufficiently.

As can be seen from Table 5.7, the majority of consonant clusters in SI emerged by age 3 years except C + /l/ clusters (pl, bl, kl, gl, sl), C + /r/ clusters (br, pr, dr, tr, kr, ɡr, fr, θr) and three-element clusters (spl, spr, str, skr), which emerged at 3;06-3;11 years, 4;00-4;11 years and 5;00-6;05 years respectively. The majority of the consonant clusters in SF emerged before age 3;06 years with the exception of /ndʒ, ntʃ/ and /ns/.

Age of mastery production of syllable-initial consonant clusters varied across different types of consonant clusters as displayed in Table 5.8. The earliest acquired two-element consonant clusters consisted of C + /j/ (mj, nj) and /s/ + C cluster (sw, sp, st, sk, sm, sn). C + /w/ (tw, kw) and C + /l/ clusters were acquired between age 6;00 and 7;06 years. C + /j/ clusters (bj, pj, kj), C + /r/ clusters and three-element clusters (except /skw/) were not mastered at the upper age limit in the present study. The age of mastery of consonant clusters in SF differed according to the type of consonant clusters. The C + stop (ft, st, sk) and nasal + C (/nt, nd, ŋk/) clusters were acquired earlier than the other clusters. The /l/ + C clusters (/lt, lk, lf/), nasal + C (/ndʒ, ntʃ / and /ns/) were not mastered even in the oldest age group. Figures 5.2 and 5.3 respectively display the age of customary production and mastery production of syllable-initial and syllable-final consonant clusters.

Table 5.7: Age of Customary Production of MalE Consonant Clusters Taking MalE Dialectal Features into Consideration

Age Group	Syllable Initial (SI)	Syllable Final (SF)
3;00-3;05	mj, nj bj, pj, kj sw sp, st, sk sm, sn **tw, kw** fl skw	**ft** **st, sk** ks **lt, lk, lf** **nd, nt, ŋk** **mp**
3;06-3;11	sl bl, **pl**, gl, **kl**	ndʒ, ntʃ
4;00-4;05	fr, **θr**	
4;06-4;11	br, **pr**, dr, **tr**, gr, **kr**	-
5;00-5;05	spl	-
5;06-5;11	-	ns
6;00-6;05	spr, str, skr	-

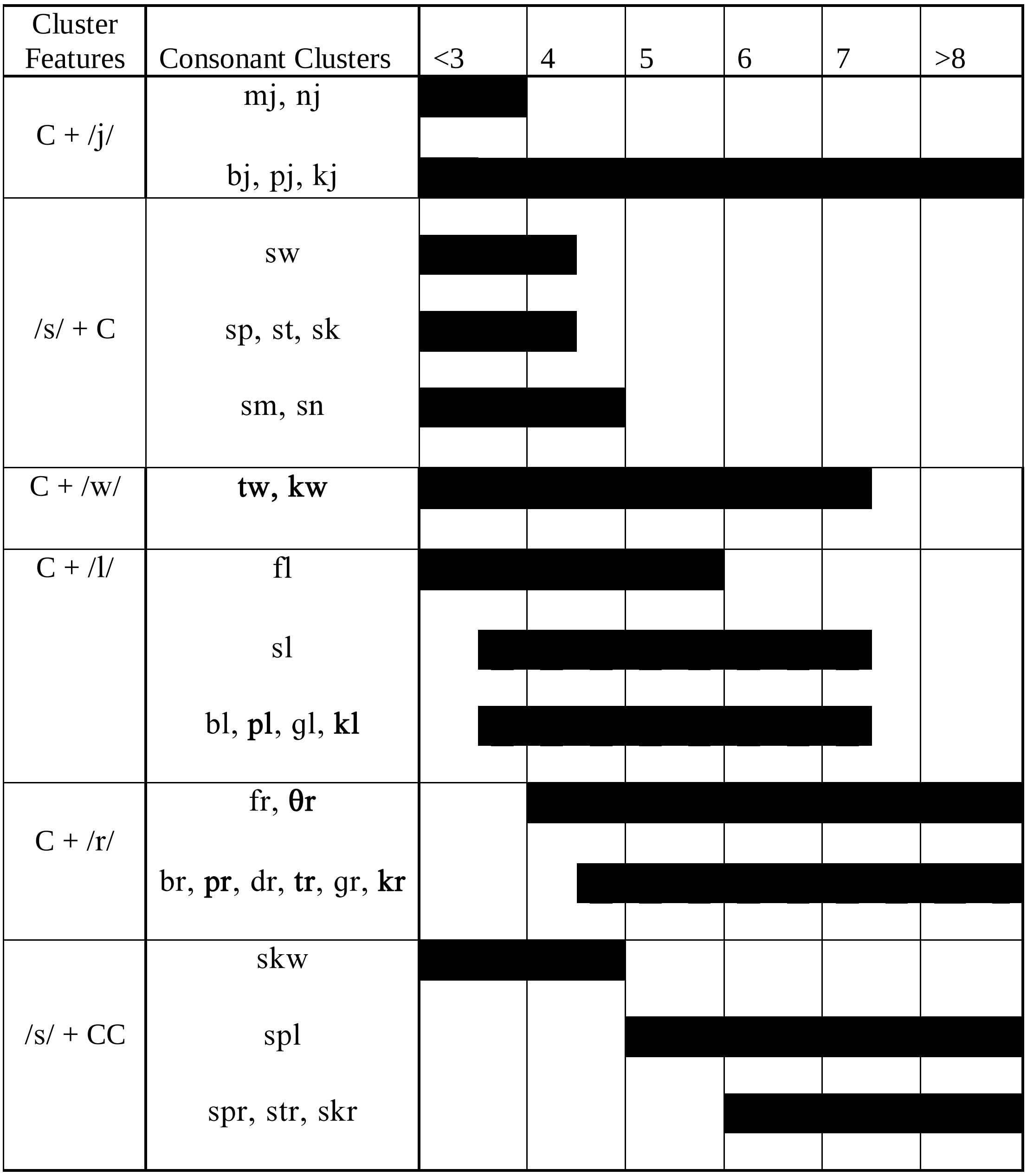
Notes: SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
SF refers to SFWF (syllable-final word-final)
Consonant clusters in **bold** are consonant clusters produced with significant variants which are acceptable in MalE.

Table 5.8: Age of Mastery Production of MalE Consonant Clusters Taking MalE Dialectal Features into Consideration

Age Group	Syllable Initial (SI)	Syllable Final (SF)
3;00-3;05	-	**ft**
3;06-3;11	mj, nj	-
4;00-4;05	sw sp, st, sk	-
4;06-4;11	sm, sn skw	**nt, nd, ŋk**
5;00-5;05		**st, sk**
5;06-5;11	fl	-
6;06-6;11	-	ks **mp**
7;00-7;05	**tw, kw** sl bl, **pl**, gl, **kl**	-
>8	bj, pj, kj fr,**θr** br, **pr**, dr, **tr**, gr, **kr**, spl spr, str, skr	**lt, lk, lf** ndʒ, ntʃ ns

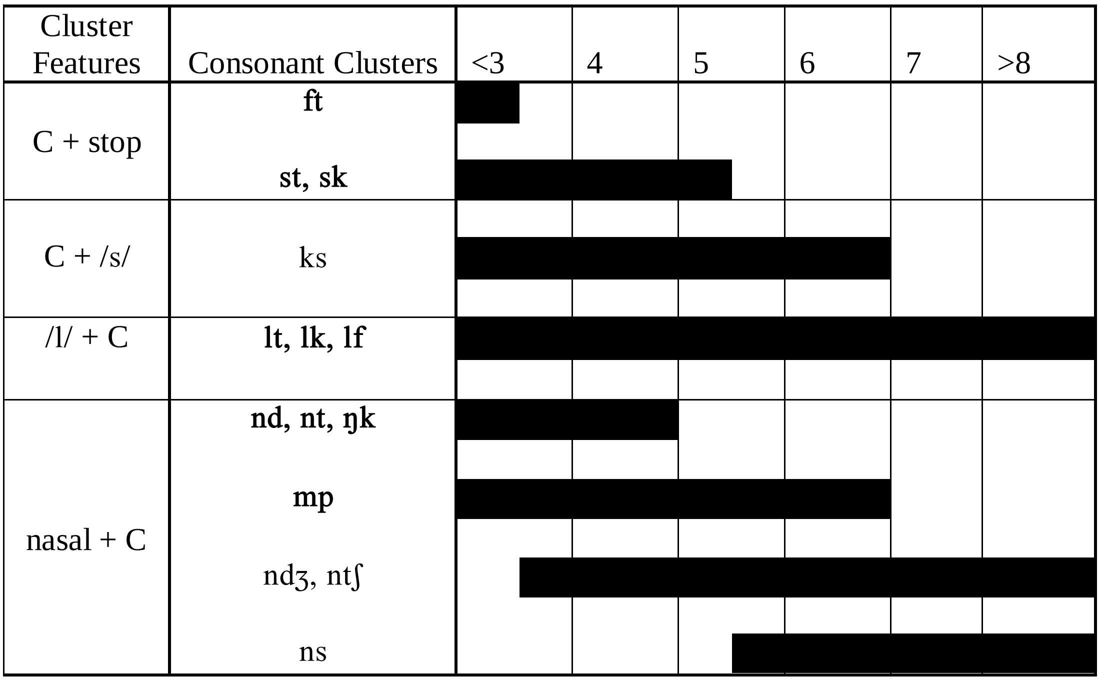
Notes: SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
SF refers to SFWF (syllable-final word-final)
Consonant clusters in **bold** are consonant clusters produced with significant variants which are acceptable in MalE.

Figure 5.2: Age of MalE Syllable-Initial Consonant Cluster Acquisition Taking MalE Dialectal Features into Consideration



Notes:
- The solid bar corresponding to each sound begins at the median age of customary production and ends at an age of mastery.
- Syllable-Initial refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word).
- /sw/ could be placed either in /s/ + C or C + /w/. /sw/ was treated like other /s/ + C clusters because /sw/ behaved like other /s/ + C clusters.
- /sl/ could be placed either in /s/ + C or C + /l/. /sl/ was included in the category of C + /l/ as the age of acquisition of /sl/ was similar to other C + /l/ clusters.
- Consonant clusters in **bold** are consonant clusters produced with significant variants which are acceptable in MalE.

Figure 5.3: Age of MalE Syllable-Final Consonant Cluster Acquisition Taking MalE Dialectal Features into Consideration



Notes:
- The solid bar corresponding to each sound begins at the median age of customary production and ends at an age of mastery.
- Syllable-final refers to SFWF (syllable-final word-final).
- Consonant clusters in **bold** are consonant clusters produced with significant variants which are acceptable in MalE.

5.2.7 Comparison of Age of Consonant Cluster Acquisition in MalE and SE

The age of MalE consonant cluster acquisition in the present study was compared to findings from three previous studies of SE (Wellman et al., 1931; Templin, 1957; Smit, 1990). Table 5.9 compares the age of acquisition of 22 subcategories of consonant clusters. All three previous studies of SE showed very similar findings. The present data generally showed ages of acquisition equal to or younger than the ages reported in the previous studies of SE. A major exception was C + /w/ (/tw, kw/), which reached the 90% criterion relatively late in the present study. All initial /s/ + C clusters and C + stop clusters were acquired earlier than the age reported in the previous studies.

Table 5.9: Comparison of the Age of Consonant Cluster Acquisition in MalE and SE

Syllable Position	Clusters	3;0	3;6	4;0	4;6	5;0	5;6	6;0	6;6	7;0	7;6	8;0	9;0	>6	>7	>8	>9
Syllable-Initial	mj, nj		♦														
	pj, bj, kj														♦		
	sw			♦								T		W			S
	sp, st, sk			♦								T	S	W			
	sm, sn				♦							T		W			S
	tw, kw					W	S	T		♦							
	fl					W	♦	T S									
	sl									♦		T	S	W			
	pl, bl, kl, gl					W		S		♦ T							
	fr, θr									T			S	W	♦		
	pr, br, tr, dr, kr gr									T		S		W	♦		
	skw				♦					T			S	W			
	spl											T	S	W	♦		
	spr, str, skr								W			T				S ♦	
Syllable-Final	ft	♦								T							
	st, sk						♦					T		W			
	ks								♦	T				W			
	lt, lk, lf									T				W	♦		
	nt, nd, ŋk				♦					T				W			
	mp					W		T	♦								
	ntʃ, ndʒ														♦		
	ns													W	♦		

W- Wellman et al. (1931)
T - Templin (1957)
S - Smit et al. (1990)
♦ - Present Study

5.3 DISCUSSION

The results of the age of acquisition of MalE consonants, vowels and consonant clusters indicated that MalE speaking children were acquiring speech sounds differently to SE. The discrepancies in the findings will now be discussed.

5.3.1 Acquisition of MalE Consonants

There are a number of possible reasons that lead to differences in consonant acquisition in comparison to SE. First, the dialectal variation of MalE was considered when deriving age of consonant acquisition. For instance, the phonological features of MalE include final consonant devoicing, dental fricative avoidance, glottalization of final stops, final consonant /l/ omission and vocalization and substitution of labiodental /v/. Therefore, MalE had its own realization rules that were substantially different from SE. When MalE serves as the speech model, children are learning from a simpler form of English. Due to the nature of the phonemic approach where the MalE speaking adults' model was taken into consideration when deriving norms for children, it appeared that many consonants were acquired earlier in MalE than SE, for example, /v/, /ð/, /ʒ/ in SI and /t/, /d/, /g/, /l/ in SF. These are the phonemes that have been identified as having significant MalE variants. The consideration of MalE variants has implications for ages of acquisition of speech sounds. For instance, as can been seen from Figure 5.1, the chart looks as though MalE speaking children are acquiring [v] when they are in fact acquiring a phoneme (which could be realized as [w] syllable-initially and [f] syllable-finally), not a phonetic realization. This raises a question whether /v/ is a phoneme. The consonants which were acquired earlier due to the consideration of MalE were:

- The /v/ sound in SI was reported to be acquired in the range of 5 to 8 years or even older in SE; however, /v/ was acquired as early as 3;06 years old in MalE. This is because /v/ is produced as [w] in MalE. The /w/ sound is among the earliest acquired sounds in SE (Goldman, et al., 2000; Smit, et al., 1990; Templin, 1957).
- The /ð/ sound in SI was acquired within the range of 5;06 to 8 years or older in SE, but was acquired at age of 4 in MalE. This is due to the realization of /ð/ as [d] in MalE, since /d/ was also acquired quite early in SE, between 3 to 5 years

old (Goldman, et al., 2000; Smit, et al., 1990; Templin, 1957; Wellman, et al., 1931).

- The /ʒ/ sound in SI was acquired by 5 year old children in MalE but was acquired by children older than 8 years in SE. The /ʒ/ sound will be considered acquired if it is produced as [ʃ] in MalE and /ʃ/ is usually acquired earlier than /ʒ/ in SE.
- The /t/, /d/ and /g/ sounds in SF were acquired slightly earlier in MalE than SE. These consonants were frequently realized as glottal stops in MalE. Glottal stops are easier to produce as many children with phonological disorders use glottal stops to substitute for medial (Dunn & Davis, 1983) and final (Grunwell & Yavas, 1988) obstruents.
- The /l/ sound in SF was found to be acquired by children older than 8 years old in SE, while in MalE, it was acquired by 3 years of age, because the production of /l/ was considered correct even if it was omitted or vocalized in MalE.

Second, methodological differences in terms of approach (phonetic versus phonemic acquisition) and method of analysis (considering spontaneous or imitated speech), nature of the stimuli and familiarity of vocabulary, might contribute to the differences in findings.

- The present study implemented a phonemic approach, in which children's realization of words was compared with the adults' model. Some of the previous normative studies have used a phonetic approach. For example, Dodd, Holm, Hua, & Crosbie (2003), included a sound in a child's inventory regardless of the model of adult realization. Phonetic acquisition would be expected to occur earlier compared to phonemic acquisition because children's productions are considered without reference to the target responses in the phonetic analysis.
- Children's speech responses in both spontaneous and imitation forms were considered in the present study. Some normative studies included both spontaneous and imitative responses (Dodd, et al., 2003; Templin, 1957), while others included mainly spontaneous responses due to the nature of the elicitation procedures (Wellman, et al., 1931). Smit (1986) speculated that the mixture of spontaneous and imitative productions might affect the results.

- The differences in the stimuli might also contribute to the discrepancies in the findings. The inclusion of words in syllable-initial, within-word position (SIWW) contributed the later acquisition of some consonants.
    - The consonants /h/ and /w/ are usually among the earliest acquired consonants in SE, normally at 3 years old or earlier in normative studies. Nonetheless, /h/ and /w/ were acquired at the age of 4;00-4;06 in the present study. The words *sandwich* and *grasshopper* were respectively sampled to target for /w/ and /h/ in the present study. Here the sounds were sampled in SIWW and might be prone to errors due to the phonetic environment. James, van Doorn, & McLeod (2008) found that 60% of consonant deletions among typically developing children, aged three to seven years, occur in sequences within words rather than at their edges. Davis's (1998) study of consistency of consonant patterns by word position in ten phonologically disordered children revealed that there were significant differences across word positions in the consonant phonetic inventory. More consonants were produced correctly in SIWI than SIWW or SFWW. It is thus suspected that the later acquisition of /w/ and /h/ in the present study might be due to the inclusion of words where the consonants are in SIWW. The exclusion of SIWW words in /h/ and /w/ would likely lower the age of acquisition of both sounds to 3;00-3;05 years old.
    - Likewise, inclusion of /p/ in SFWW also affected the age of acquisition of syllable-final /p/. Bilabial stops are one of the earliest acquired consonants in SE (Goldman, et al., 2000; Smit, et al., 1990; Templin, 1957). The /p/ sound in SFWF (e.g. *up*, *sheep*, *zip*) was mostly produced correctly, but /p/ in SFWW was prone to errors. The target word, *helicopter* /hɛlɪkɒpt̬ə/ was the only word sampled for /p/ in SFWW. The /p/ sound was occasionally produced as /k/ in *helicopter* as a result of progressive velar assimilation. Velar assimilation was reported in 11-20% of Australian children aged 5 to 7 years old due to the production of helicopter as [hɛlikɒktə] because children have not yet fully mastered the coarticulatory movements to accommodate velar sounds. (James, McCormack, & Butcher, 1999). Therefore, the same condition might apply to MalE in the present study. It is necessary to be

aware that the age of acquisition for /p/ in SFWF might reduce to 3 years of age if /p/ in SFWW was not included.

- Word choice might also affect the acquisition of /b/ in MalE. The /b/ sound is acquired earlier in SE (Goldman, et al., 2000; Smit, et al., 1990; Templin, 1957). However, in MalE, syllable-final /b/ was acquired at age 7 years or older. Two words, *crab* and *web*, were sampled to target /b/ in SF. Children occasionally produced /b/ inaccurately in both words, with more errors observed in *web* than *crab*. These two words were not specifically difficult in terms of syllable structure (CVC for web and CCVC for crab) or phonetic environment (/b/ was preceded by vowel in both words). The only reason might be the familiarity of words. The word *crab* appeared to be more familiar to children than the word *web*, as 94% of the children at 3 years old named *crab* spontaneously and only 29% of children labelled *web* spontaneously. If the word *web* is excluded and the age of acquisition was determined based solely on the word *crab*, /b/ would be considered acquired at age of 4 years.

Third, the cross-linguistic effects resulting from Mandarin Chinese and Malay might cause different acquisition patterns of MalE consonants. It was hypothesized in the present thesis that MalE speaking children might show earlier acquisition of MalE sounds which are phonetically similar (shared) between English, Mandarin Chinese and Malay due to increased production experience (Fabiano-Smith & Goldstein, 2010; Goldstein, Fabiano, & Iglesias, 2003). In contrast, phonetically dissimilar sounds (unshared sounds) between English, Mandarin Chinese and Malay might be acquired later due to lack of production opportunities. Shared and unshared sounds among English, Mandarin Chinese and Malay could account for the following effects:

i) Sounds that are shared and are acquired earlier in MalE than SE

- Syllable-initial /s/ was acquired earlier in MalE than in SE, as /s/ was shared in both Mandarin Chinese and Malay. Thus, more opportunities of production were granted, and this accelerated the acquisition of /s/.
- Syllable-initial /j/ was acquired earlier in MalE than in SE as it was shared in both Mandarin Chinese and Malay.
- Syllable-initial liquids /l/ and /r/ were acquired earlier than SE. /l/ in English was shared in both Mandarin Chinese and Malay. /r/ was not produced as an

approximant but respectively produced as a retroflex and a trill in Mandarin Chinese and Malay. Since all these consonants were shared in Mandarin Chinese and Malay, the acceleration of /l/ and /r/ acquisition occurred in MalE, in spite of realization differences for /r/.

- Syllable-final nasals (m, n, ŋ) were shared in English, Mandarin Chinese and Malay, therefore acceleration might occur and thus they were acquired early in MalE, between the ages of 3 and 4 years.
- Syllable final /l/ was shared within Malay. However, early acquisition of syllable-final liquid /l/ occurred due to consideration of MalE dialectal features rather than because it was shared. Vocalization and omission of /l/ were considered normal in the account of /l/ acquisition.

ii) Sounds that are not shared and are acquired later in MalE than SE

- Later acquisition of syllable-initial /z/ was evident in the present study. The /z/ sound in SI was not acquired even in the oldest age group. The /z/ sound in English was not shared in Mandarin Chinese and Malay. It is thus not surpring that /z/ was acquired later.
- None of the syllable-final fricatives in English were shared with Mandarin Chinese and Malay, with the exception of /s/ which was shared with Malay. Most of the syllable-final fricatives which were not shared with Mandarin Chinese and Malay (v, θ, ʃ, f, z) were acquired later, except /f/ and /z/.
- Syllable-final affricates /tʃ/ and /dʒ/ are not used in Mandarin Chinese and Malay. Therefore, later acquisition of syllable-final affricates in MalE is to be expected.

iii) Sounds that are not shared but are acquired earlier in MalE than SE

- Syllable-final stops in English are not a feature of Mandarin Chinese and Malay, therefore, the acquisition of syllable-final stops would be expected to occur later. However, due to MalE variant consideration of final stops being realized as glottal stops, both stops in SI and SF were acquired at the same time, except /b/ and /p/ which have been previously discussed.

- Syllable-final /f/ was acquired early even though this feature is not evident in Mandarin Chinese and Malay. Nonetheless, /f/ is borrowed from Arabic consonants into the Malay language, for example, 'taraf' /taraf/ ('standard' in English). (Hashim and Lodge, 1988; cited by Lodge, 2009) and this might help in the acquisition of /f/ in English.
- Syllable-final /z/ was acquired earlier because the realization of /z/ as [s] was a dialectal feature of MalE and was considered in the derivation of age of consonant acquisition. In other words, the acquisition of syllable-final /z/ will be almost equivalent to acquisition of syllable-final /s/.

iv) Sounds that are shared but are acquired later in MalE than SE

- Even though syllable-initial /ŋ/ was shared in Malay, later acquisition of syllable-initial /ŋ/ in MalE might occur due to the absence of syllable-initial /ŋ/ in Mandarin. According to Zhao (1995), /ŋ/ in medial position is a difficult sound for adult Chinese speakers of English. Although syllable-initial /ŋ/ was produced correctly by MalE speaking adults, children who are still developing their speech sounds might find it difficult.
- Syllable-initial /w/ and /h/ should be acquired earlier than SE as both sounds are shared in both Mandarin Chinese and Malay. However, both sounds were found to be acquired later than SE. This is because acquisition of /w/ and /h/ was affected by the phonetic environment of the word as discussed before.

5.3.2 Acquisition of MalE Vowels

The acquisition of vowels in the present study was almost complete by age 3 with the exception of /ʊ/ and /ɪə/. This finding was in accordance with judgments made by Smit et al. (1990) who mentioned that vowel errors are scarce after 3 of age. Likewise, Pollock & Berni (2003) found that the majority of typically developing 3 year old children produce non-rhotic vowels correctly, implying that the English vowel system is nearly intact at this age. In the present study, /ʊ/ was acquired by 3;06-3;11 years and /ɪə/ was acquired at 5;06-6;00 years. The later acquisition of /ʊ/ and /ɪə/ was most probably due to methodological factors rather than reflecting an actual developmental phenomenon. The frequency of occurrence of the vowels in different studies may affect the age of acquisition. In the present study, /ʊ/ and /ɪə/ were sampled twice and once respectively. Less frequent occurrence of these vowels in the present study may give the children less opportunity to produce them and as a result, these vowels are less likely to be correctly produced. Furthermore, the sample size was small for the youngest age group, so even a small error would result in a higher percentage inaccuracy. Overall, /ʊ/ and /ɪə/ appeared to be acquired later than all other vowels, whereas in fact, their developmental patterns might be parallel to the other vowels.

In the present study, /ə/ was acquired at 3;00-3;05 which was similar to the age reported by Wellman et al. (1931). Nonetheless, it was acquired much earlier compared to Templin (1957) who reported that the acquisition /ə/ is only complete by age 6;00-6;11 years. The central unrounded vowel /ə/ is one of the vowels that predominate a child's first word productions (Davis & MacNeilage, 1990; Stoel-Gammon & Herrington, 1990). Therefore, the late acquisition of /ə/ in Templin's (1957) study is somewhat unusual. The vowel /ə/ was sampled in the word *upon* for 3 to 5 year old children and *amount* for 6 to 8 year old children in Templin (1957). There is a major concern with these words. The vowel /ə/ in both words appears in non-final weak syllables (e.g. *upon* /ə̲pɒn/, *amount* /ə̲maʊnt/), which are vulnerable to change compared to /ə/ in final weak syllable (e.g. *tiger* /taɪgə̲/) (James, van Doorn, & Mcleod, 2001). Goffman & Malin (1999) found that greater articulatory movement control is needed for the production of non-final weak syllables than final weak syllables. Therefore, it is not surprising that /ə/ was acquired later in Templin (1957) than in the present study which sampled /ə/ in different syllable positions.

5.3.3 Acquisition of MalE Consonant Clusters

Because children find consonant clusters difficult (Smit, 1993a; Smit, et al., 1990), consonant clusters have been described as the long-lasting aspect of speech sound development. Children usually undergo several stages of cluster development before the final correct production. Greenlee (1974), for instance, proposed a four-stage route to the normal development of consonant clusters: i) the entire cluster is deleted, ii) reduction to a single consonant, iii) the number of elements is preserved but one or more of the consonants in the cluster is substituted, and iv) correct production. In view of the complex stages of cluster development, it is not surprising that children's consonant cluster acquisition is complete at a later age.

The ages of acquisition of consonant clusters were wide-ranging in the present study. Some consonant clusters (e.g. /mj, nj/) were acquired as early as 3 years of age. However, mastery of some consonant clusters (e.g. C + /r/ clusters and three-element clusters) was not observed even at the upper age limit of this study. The order of consonant clusters acquired by MalE speaking children was nasal + glide, /s/ + C clusters, C + /w/ and C + /l/ clusters. The C + /r/ clusters, stop + /j/ clusters and three-element clusters (except /skw/) were not mastered by the oldest age group in the present study. Generally, ages of consonant cluster acquisition in the present study were equal to or younger than the ages reported in previous studies of SE (Wellman et al., 1931; Templin, 1957; Smit, 1990).

A comparison of consonant cluster acquisition in MalE and SE revealed the following:

i) Clusters that could not be compared

Comparison could not be made for some clusters because these clusters are not commonly reported in the normative studies (e.g. C + /j/ clusters /mj, nj/ and /bj, pj, kj/ clusters).

- Age of acquisition of /mj, nj/ were not reported. Nonetheless, in French's (1989) longitudinal study, [nj] was reported in the production of a 23 month old child. It is thus possible to predict that nasal + glide (mj, nj) clusters would be acquired earlier compared to other cluster types because they consist of earlier acquired singletons (nasals and glides).
- Acquisition of /bj/, /pj/ and /kj/ could not be compared due to lack of resources in this regard. The /bj/, /pj/ and /kj/ clusters were acquired relatively late in the present study. Mastery level was not achieved even at the upper age limit of the present study. The late acquisition of these clusters was due to deletion of the /j/ sound in the clusters. Some of the possible factors that may have influenced the deletion of /j/ sound in stop + /j/ clusters have been discussed in the literature. These factors include consonant cluster sequences, especially within words, the requirement for an anterior-posterior or posterior-anterior articulation and the

presence of sonorant sounds (James, et al., 2008). The /bj/, /pj/ and /kj/ clusters were respectively sampled in words *ambulance* /æmbjuləns/, *computer* /kəmpjutə/ and *cucumber* /kjukumbə/. /bj/ and /pj/ clusters were sampled in syllable-initial within-word position (SIWI). James et al. (2008) found that 66% of all consonant deletion affects consonant sequences in word-initial, within-word or word-final positions. Consonant sequences that required an anterior-posterior or posterior-anterior articulatory coordination such as in /kəmpjutə/ and /æmbjuləns/ were deleted 50% of the time and half of the consonant deletions were related to sonorant sounds /j/ being omitted in words like /kəmpjutə/ and /æmbjuləns/. The other salient factor which caused the deletion of /j/ in stop + /j/ clusters might be the influence of Malay phonology. In Malay, *ambulance* /æmbjuləns/ is pronounced as *ambulans* /ambulans/ and *computer* /kəmpjutə/ is realized as *komputer* /komputə/, where the /j/ sound is absent from both words.

ii) Clusters that are acquired at the same time as in SE

When compared with SE, similar consensus was reached for some consonant clusters in MalE. For example, three-element clusters were acquired earlier than two-element clusters.

- In the present study, three element clusters (except /skw/) emerged later than all of the two- element clusters and were not mastered even at the upper age limit of the age groups. The fact that three-element clusters are mastered later than two-element consonant clusters has been commonly supported by researchers (McLeod, van Doorn, & Reed, 2001a; Smit, et al., 1990; Templin, 1957; Wellman, et al., 1931). McLeod, van Doorn, & Reed (2001a) explained this phenomenon as the increased phonotactic complexity of blending three elements and the level of phoneme difficulty within three-element consonant clusters. The fact that /skw/ was acquired earlier compared to other three-element clusters might be due to segmental differences. Other three-element clusters, for example /spl, spr, str, skr/, contain /s/ + stop + liquid while /skw/ contains /s/ + stop + glide. The later acquisition of three-element clusters /spl, spr, str, skr/ might be attributed to the greater articulatory difficulty in producing liquid segments /l/

and /r/ in comparison to glide /w/ once the appropriate number of elements in the cluster have been attained.

iii) Clusters that are acquired earlier than in SE

- All syllable-initial /s/ + C clusters were acquired earlier than the age reported in previous studies. One factor that may have influenced the production of /s/ + C clusters is that the majority of MalE speaking children produced singleton /s/ correctly. Initial singleton /s/ was acquired by 3;00-3;06 year old children in the present study but singleton /s/ is acquired not prior to age of 7 years by 90% of the children in SE (Goldman, et al., 2000; Smit, et al., 1990; Templin, 1957; Wellman, et al., 1931). In order to be perceived as a correct production of /s/ clusters, both elements in the cluster have to be preserved and produced correctly. The correct production of singleton /s/ is a prerequisite of correct production of /s/ clusters. McLeod, van Doorn and Reed (2001a) found that 2 year old Australian children produced a few consonant clusters containing fricatives (e.g. /sp/, /st/, /sm/) correctly and all these children produced fricatives in their singleton repertoires. Therefore, the earlier acquisition of /s/ clusters is probably due to the early acquisition of singleton /s/ in MalE in comparison to SE.
- Syllable-final C + stop (ft, st, sk) and nasal + C (/nt, nd, ŋk/) clusters were acquired earlier than SE because of MalE dialectal features. The stop element in these clusters was omitted in MalE. Therefore, children who did not produce the stop element in these clusters were not penalized.

iv) Clusters that are acquired later than in SE

- /l/ + C clusters and nasal + C (/ndʒ, ntʃ/ and /ns/) clusters had to have both elements to be produced correctly in MalE, although simplification of segments were allowed (e.g. /ndʒ/ could be produced as [ntʃ] and /lk/ could be produced as [ʊk] in MalE). The production of these clusters becomes more difficult because of the increased phonotactic complexity. Children tend to omit the /l/ sound in /l/ + C clusters and the affricates and fricatives in nasal + C clusters. In spite of the phonotactic constraints, it is worth noting that the influence of Malay pronunciation might have impacted on the production of these clusters.

For example, /ndʒ/ was sampled in the word *orange* /ɒrɪndʒ/, which was produced as *oren* /ɒren/ in Malay. There is a likelihood that Malay pronunciation /ɒren/, which only contains a final singleton /n/, might have influenced the production of the /ndʒ/ clusters in English.

- C + /w/ (/tw, kw/) clusters reached the 90% criterion relatively late in the present study which was incongruent with many reports of SE which claimed that C + /w/ (/tw, kw/) clusters are one of the earlier acquired consonant clusters (Smit, et al., 1990; Templin, 1957; Wellman, et al., 1931). In the present study, /kw/ was produced correctly and consistently in the word *quack* and the 90% mastery criterion was achieved by 3;06-3;11 years old. However, the accuracy of /tw/ production was relatively lower and inconsistent across age groups. The /tw/ cluster was sampled in the word *twinkle*. Some of the children sang the word *twinkle* as in the song of 'twinkle twinkle little star' when responded to the stimulus. It is unclear whether this would have affected the production of /tw/. Children might have retained the incorrect production (e.g. [tɪŋkə] for *twinkle*) that they first learned in the song when they were toddlers. The effect of word choices for the production of /tw/ could be examined by sampling /tw/ in another word.

5.4 SUMMARY

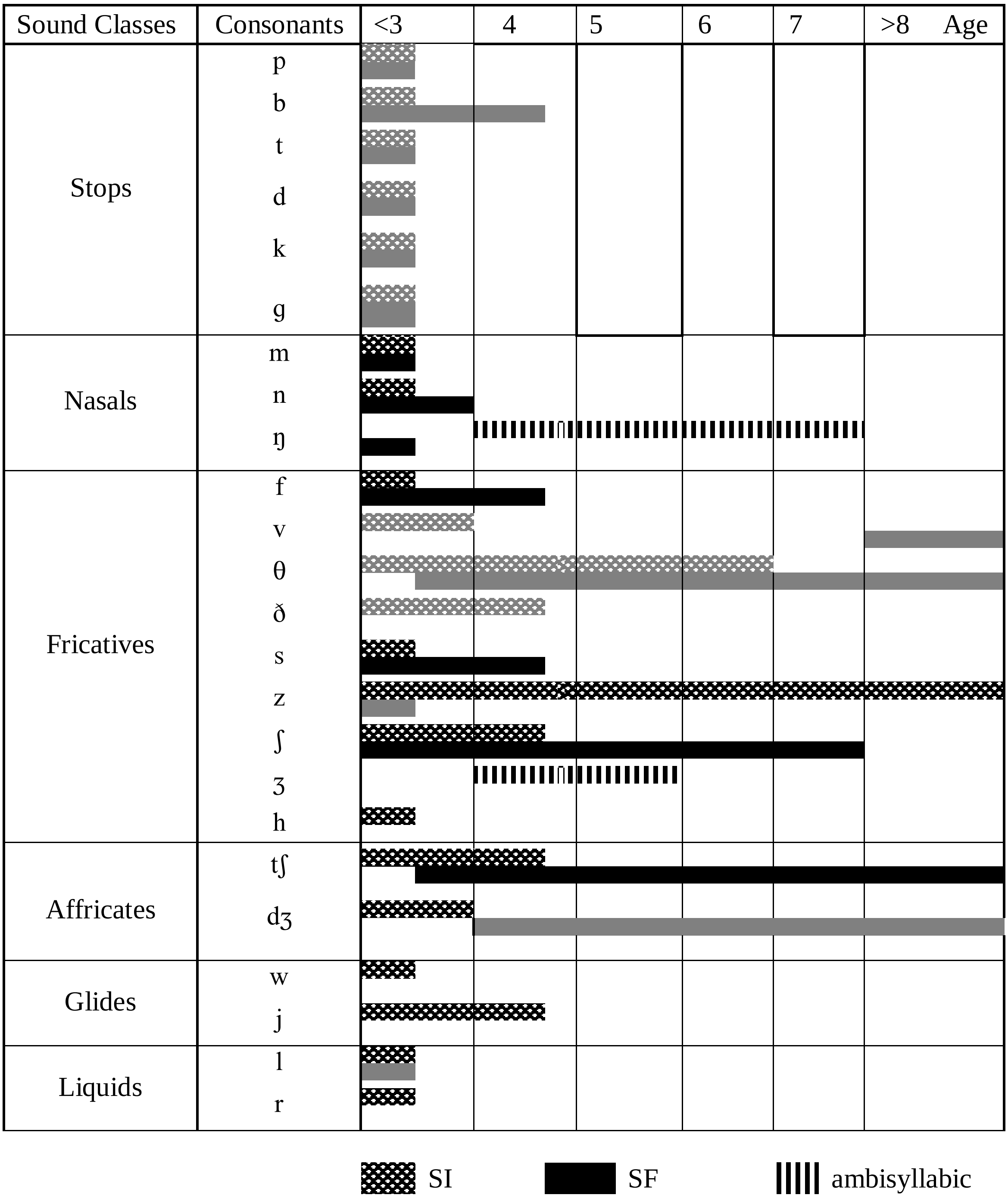
The ages of MalE consonant, vowel and consonant cluster acquisition shared some similarities, as well as clear differences compared to SE. The differences occurred in three major aspects. Firstly, the consideration of MalE dialectal features set a different standard of English for MalE speaking children. The phonological system of MalE was simplified as compared to SE. Therefore, MalE speaking children were learning from a simpler version of English. When a MalE speaking adults' model was used as a reference for deriving norms for children, it appeared that many MalE consonants were acquired earlier than SE. This finding indicates that the assessment of phonological acquisition of MalE speaking children should be carried out in relation to the standard of MalE rather than SE. SLPs need to consider MalE dialectal features when assessing

MalE speaking children. Earlier acquisition of the majority of MalE sounds is to be expected when dialectal features of MalE are considered.

Secondly, differences occurred because of the methodological differences in terms of approach and form of analysis, nature of stimuli and word choices between this study and the various SE studies. This highlights the need to clearly define the criteria used in data collection and analyses in all normative studies. The comparison of the findings in this study with other studies can only be made on a ‘like-for-like’ basis if the methodology used is comparable. If the differences in methodology are not properly acknowledged, this would result in misleading generalizations. For example, a speech sample which consists of /p/ in SFWW would yield a later age of acquisition compared to speech sample which only samples /p/ in SFWF. Therefore, SLPs are encouraged to recognize the differences in methodologies used in this study and apply the norms for this study flexibly. A revised graphic (Figure 5.4) for acquisition of MalE consonants taking into consideration all of the possible sources of methodological differences was done in order to provide a more accurate indication of how MalE consonants are acquired.

Thirdly, differences occurred because of the cross-linguistic effects that result from Mandarin Chinese and Malay being acquired simultaneously by MalE speaking children. The influence of Mandarin Chinese and Malay appeared to accelerate or delay the acquisition of speech sounds based on phonetic similarity (shared and unshared sounds). The effect of Malay loanwords potentially impacted the acquisition of some speech sounds. SLPs have to pay attention to this during assessment so that children would not simply be penalized for pronouncing English words differently due to the influence of Malay pronunciations. The findings of the present study will help SLPs to understand the phonological acquisition of MalE speaking children who are learning Mandarin Chinese and Malay the same time. The findings of the present study have confirmed differences in the acquisition patterns of MalE in comparison to SE. Clearly, SE norms are not applicable for MalE speaking children and should not be used in assessing the phonological acquisition of MalE speaking children in any instance.

Figure 5.4: Revised Age of MalE Consonant Acquisition in SI and SF Taking Methodological Differences into Consideration



Notes:

- Graphic presentation was adapted from Sander (1972).
- The solid bar corresponding to each sound begins at the median age of customary production and ends at an age of mastery.
- SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
- SF refers to SFWF (syllable-final word-final) and SFWW (syllable-final within-word)
- /ʒ/ and /ŋ/ refer only to words assessed in ambisyllabic position like *treasure* for /ʒ/ and *singing* for /ŋ/.
- The age of acquisition of /p/, /w/ and /h/ reduced to 3;00-3;05 when they were not sampled in SFWW or SIWW.
- The age of acquisition of /b/ reduced to 4;00-4;05 when it excluded unfamiliar word like *web*.
- The bars in grey indicate phonemes produced with significant variants which are acceptable in MalE.

CHAPTER 6
SPEECH SOUND ACCURACY

6.0 INTRODUCTION

This chapter presents the results of speech sound accuracy calculations carried out on the data of the present study. The focus of this analysis was to provide quantitative data in terms of children's production accuracy. The specific aims of this chapter were:

1. To determine the speech production accuracy in terms of Percentage of Consonants Correct (PCC), Percentage of Vowels Correct (PVC) and Percentage of Consonant Clusters Correct (PCCC) at different ages when assessed with and without taking MalE dialectal features into consideration.
2. To investigate whether there are significant differences between PCC, PVC and PCCC at different ages when assessed with and without taking MalE dialectal features into consideration.
3. To examine any sex and age effect in terms of PCC, PVC and PCCC.
4. To compare the speech sound accuracy in MalE with SE.
5. To determine the accuracy of consonants according to i) different sound classes, ii) syllable positions and iii) phonetic similarities at different ages.
6. To determine the accuracy of vowels according to syllable type.
7. To determine the accuracy of consonant clusters according to i) syllable positions, ii) cluster categories and iii) number of cluster constituents.

The method of calculating the speech sound accuracy will be described, followed by the description of the results and discussion.

6.1 METHODS

Four quantitative measures were calculated:

- Percentage of Consonants Correct (PCC): the percentage of consonants produced correctly divided by the total number of consonants elicited in the target sample.
- Percentage of Vowels Correct (PVC): the percentage of vowels produced correctly divided by the total number of vowels elicited in the target sample.
- Percentage of Consonant Clusters Correct (PCCC): the percentage of consonant clusters produced correctly divided by the total number of consonant clusters elicited in the target sample.

- Percentage of Phonemes Correct (PPC): the percentage of phonemes produced correctly divided by the total number of phonemes elicited in the target sample.

All these measures were further divided:

- One set of calculations in which MalE dialectal features were taken into consideration
- One set of calculations in which MalE dialectal features were **not** taken into consideration (indicated with ‘n’)

Further detail of the dialectal features of MalE which were considered here is given in Appendix P.

6.2 RESULTS

6.2.1 Speech Sound Accuracy in MalE with and without Dialectal Consideration

Figures 6.1, 6.2, 6.3 and 6.4, respectively show pairs of measures of PCC-PCCn, PVC-PVCn, PCCC-PCCCn and PPC-PPCn in MalE speaking children from age 3 to 7 years. These pairs of measures increased as age increased. However, the measure which took MalE dialectal features into consideration was consistently higher than the other (indicated with ‘n’) across all measures. Paired *t*-tests were conducted to compare speech sound accuracy with and without MalE dialectal consideration (PCC-PCCn, PVC-PVCn, PCCC-PCCCn and PPC-PPCn). The results of the paired *t*-tests indicated that speech sound accuracy without MalE dialectal consideration was significantly lower than speech sound accuracy with MalE dialectal consideration. The results of significant differences for each of these measures are displayed in Table 6.1. The results revealed that speech sound accuracy differed greatly when MalE dialectal features were not considered. However, each of these measures patterned in the same way whether MalE dialectal features were considered or not.

Table 6.1: Paired *t*-test for Speech Sound Accuracy with and without MalE Dialectal Consideration

Measures	With MalE Consideration		Without MalE Consideration (indicated with ‘n’)		*t (263)*	*p*	*r*
	M	*SD*	*M*	*SD*			
PCC	92.79	5.56	74.11	5.50	109.51	< 0.0001	0.874
PVC	96.83	1.84	78.55	2.07	145.29	< 0.0001	0.457
PCCC	80.18	13.93	51.96	12.75	78.180	< 0.0001	0.907
PPC	93.37	4.45	74.02	4.12	136.072	< 0.0001	0.858

Figure 6.1: Display of PCC with (♦) and without (■) MalE Dialectal Features Taken into Consideration

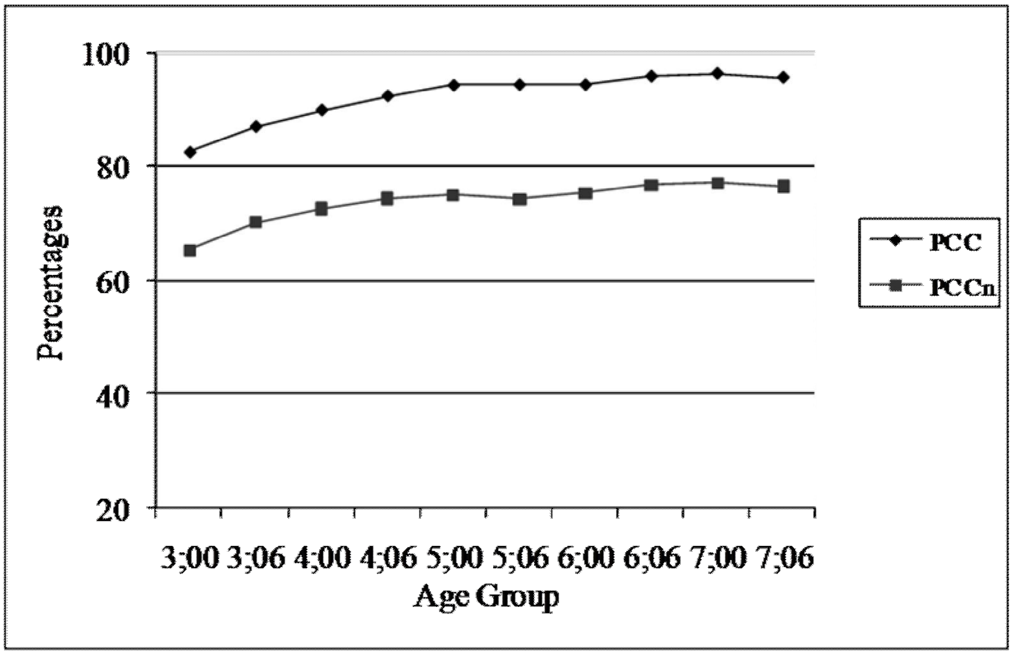


Figure 6.2: Display of PVC with (♦) and without (■) MalE Dialectal Features Taken into Consideration

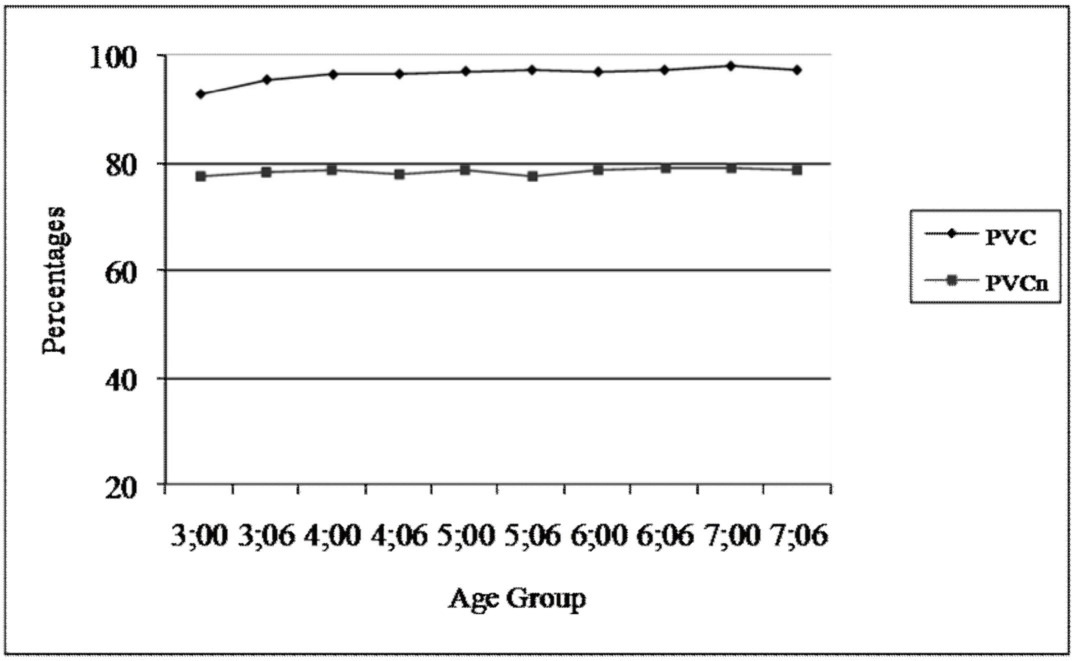


Figure 6.3: Display of PCCC with (♦) and without (■) MalE Dialectal Features Taken into Consideration

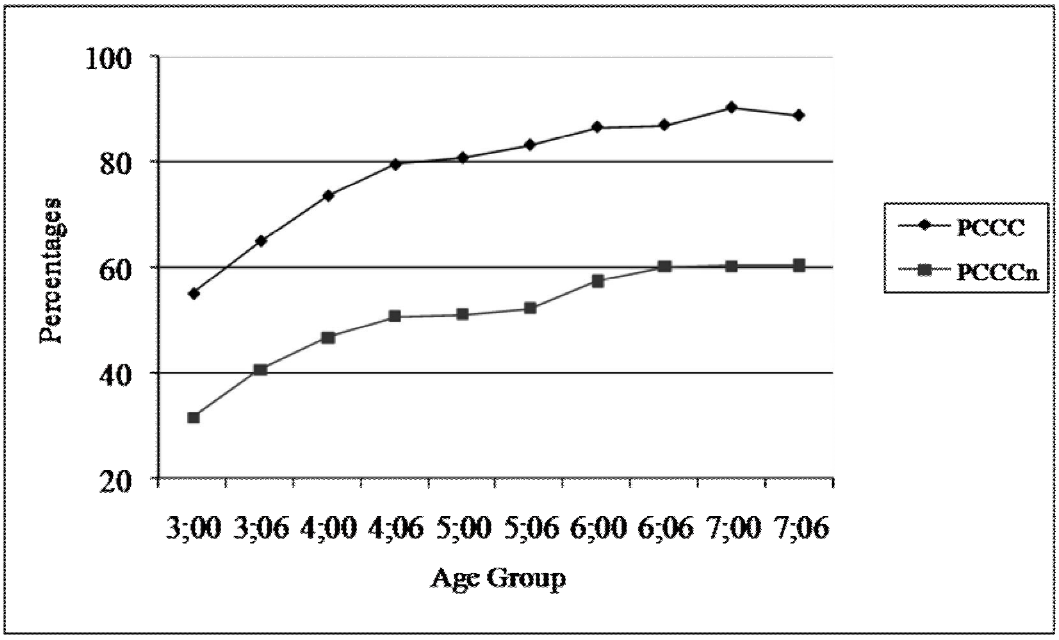
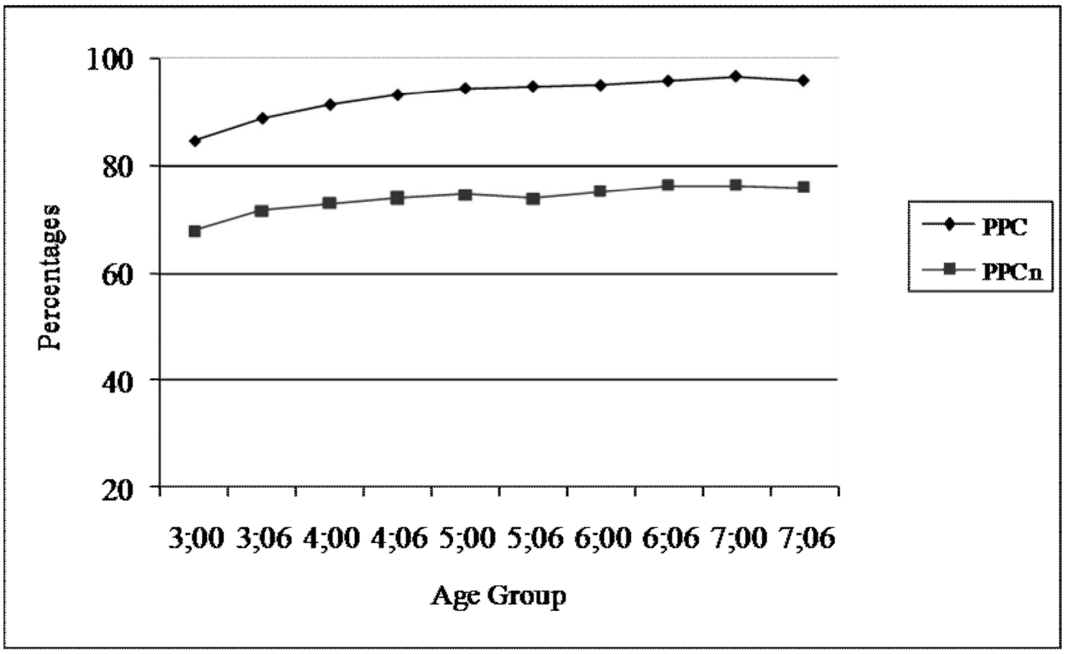


Figure 6.4: Display of PPC with (♦) and without (■) MalE Dialectal Features Taken into Consideration



6.2.2 Speech Sound Accuracy according to Sex and Age Groups

Mean percentages and standard deviations for PCC, PVC, PCCC and PPC for each age group (in 6-month intervals) according to sex are shown in Table 6.2. The older children performed more accurately than the younger children on all four speech sound accuracy measures.

The combined effects for age group and sex with the speech sound accuracy data (PCC, PVC, PCCC, PPC) were examined based on a Univariate Analysis of Variance (ANOVA). The results indicated significant effects of age group on speech sound accuracy (PCC, PVC, PCCC and PPC), F (9, 244) = 24.379, 17.104, 28.550 and 28.942 respectively, $p < 0.0001$ for all of these measures. The results did not show significant effects of sex on speech sound accuracy (PCC, PVC, PCCC and PPC), F (1, 244) = 2.324, 1.668, 0.580 and 2.082, p = 0.129, 0.198, 0.447 and 0.150, respectively. The results also revealed no sex-age group interaction with speech sound accuracy (PCC, PVC, PCCC and PPC), F (9, 244) = 0.831, 1.337, 1.245 and 1.022, p = 0.588, 0.218, 0.268 and 0.423 respectively.

In order to determine which children were developmentally at the same phonological level in a statistical way, Post-hoc *Bonferroni* tests[4] ($p < 0.05$) were conducted. The comparison revealed that speech sound accuracy was significantly different between the children in the following groups:

For PCC,

- 3;00-4;05 year old children were significantly different from 4;06-7;11 year old children.

For PVC,

- 3;00-3;05 year old children were significantly different from all the other age groups;
- 3;06-3;11 year old children were significantly different from 5;00-7;11 year old children.

For PCCC,

- 3;00-3;11 year old children were significantly different from other age groups;
- 4;00-4;05 year old children were significantly different 5;06-7;11 year old children;

[4] As indicated in chapter 4, all statistical analysis was carried out in SPSS which automatically adjusts the alpha level to correct for multiple sampling of the data pool.

- 4;06-4;11 year old children were significantly different from 7;00-7;11 year old children.
- 5;00-5;05 year old children were significantly different from 7;00-7;05 year old children.

For PPC,

- 3;00-3;05 year old children were significantly different from all the other age groups;
- 3;06-3;11 year old children were significantly different from 4;06-7;11 year old children.
- 4;06-4;11 year old children were significantly different from 7;00-7;05 year old children.

Table 6.2: Mean Percentage and Standard Deviation of Speech Sound Accuracy according to Sex and Age Group

Measures	Sex	Age Groups									
		3;00-3;05 (n = 15)	3;06-3;11 (n = 26)	4;00-4;05 (n = 29)	4;06-4;11 (n = 30)	5;00-5;05 (n = 30)	5;06-5;11 (n = 30)	6;00-6;05 (n = 31)	6;06-6;11 (n = 13)	7;00-7;05 (n = 30)	7;06-7;11 (n = 30)
PCC	F	83.8 (8.5)	88.7 (4.9)	90.7 (6.8)	92.7 (3.6)	93.9 (1.6)	94.7 (3.7)	94.5 (2.8)	96.0 (2.6)	96.6 (1.7)	95.7 (2.1)
	M	81.0 (10.2)	84.5 (8.3)	89.3 (3.4)	92.4 (3.0)	94.8 (2.0)	94.3 (2.8)	94.5 (4.0)	95.8 (3.1)	96.3 (1.4)	95.9 (3.1)
	Total	**82.5 (9.1)**	**87.1 (6.6)**	**90.0 (5.2)**	**92.5 (3.3)**	**94.4 (1.8)**	**94.5 (3.2)**	**94.5 (3.3)**	**96.0 (2.6)**	**96.5 (1.5)**	**95.8 (2.6)**
PVC	F	93.5 (3.6)	96.3 (1.8)	96.8 (1.7)	96.3 (1.4)	97.2 (0.8)	97.5 (0.9)	97.1 (1.3)	97.4 (1.3)	98.4 (0.7)	97.1 (1.2)
	M	92.6 (3.2)	94.7 (2.5)	96.4 (1.5)	97.0 (1.2)	97.2 (1.3)	97.3 (1.0)	97.1 (1.0)	97.2 (1.4)	97. 9 (0.9)	97.7 (0.9)
	Total	**93.1 (3.3)**	**95.7 (2.2)**	**96.6 (1.6)**	**96.7 (1.3)**	**97.2 (1.0)**	**97.4 (0.9)**	**97.1 (1.2)**	**97.4 (1.3)**	**98.1 (0.8)**	**97.4 (1.1)**
PCCC	F	52.3 (19.6)	69.9 (13.1)	76.0 (12.4)	79.1 (8.8)	81.4 (9.2)	82.8 (9.8)	87.8 (5.9)	86.5 (5.7)	91.0 (5.0)	88.2 (5.6)
	M	58.5 (18.1)	57.5 (19.2)	71.5 (13.0)	80.1 (10.8)	80.3 (6.2)	83.8 (8.2)	85.5 (10.1)	88.5 (6.5)	89.7 (4.9)	89.7 (5.7)
	Total	**55.2 (18.7)**	**65.2 (16.5)**	**75.7 (12.7)**	**79.6 (9.7)**	**80.9 (7.7)**	**83.3 (8.9)**	**86.7 (8.1)**	**87.1 (5.8)**	**90.4 (4.9)**	**88.9 (5.6)**
PPC	F	85.1 (6.9)	90.2 (3.8)	92.0 (4.7)	93.0 (2.6)	94.2 (1.6)	94.8 (2.8)	95.0 (2.2)	95.8 (2.0)	96.8 (1.3)	95.6 (1.7)
	M	83.8 (7.5)	86.4 (6.3)	90.7 (3.1)	93.2 (2.6)	94.5 (1.5)	94.6 (2.3)	94.8 (3.0)	95.7 (2.5)	96.4 (1.1)	96.1 (2.2)
	Total	**84.5 (7.0)**	**88.7 (5.2)**	**91.3 (3.9)**	**93.1 (2.6)**	**94.4 (1.5)**	**94.7 (2.5)**	**94.9 (2.6)**	**95.8 (2.0)**	**96.6 (1.2)**	**95.9 (1.9)**

6.2.3 Variation of PCC, PVC, PCCC and PPC across Different Ages

When describing general trends for phonological acquisition, it is important to understand the individual variability in children's phonological development. Such variability will help to describe differences between children in their rates and accuracy of speech sound production. In order to observe individual variation in speech sound accuracy, the accuracy scores (PCC, PVC, PCCC and PPC) of the individual children (n = 264) are plotted against age in Figures 6.5, 6.6, 6.7 and 6.8. As can be seen from all four figures, more and greater variability was observed in the younger children in comparison to older children. The majority of the older children demonstrated higher percentages of correct production as indicated by the grouping of the older children in the top right quadrant. However, it is worth noting that children at age 7;06 years old had more variability than 7 years old. A number of children had lower scores than other children at this age. Generally, PVC had less variability than PCC and PCCC, and PCC had less variability than PCCC. PPC reflected the overall accuracy of children's speech production.

Figure 6.5: PCC Compared with the Age of Individual Children (n = 264)

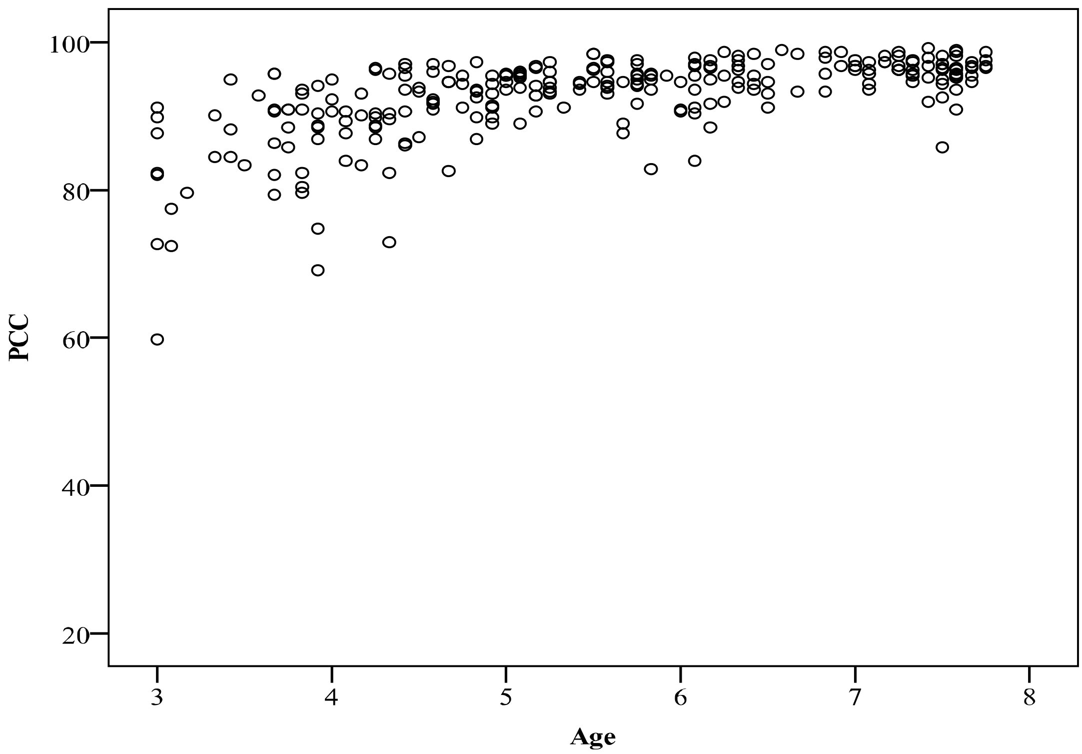


Figure 6.6: PVC Compared with the Age of Individual Children (n = 264)

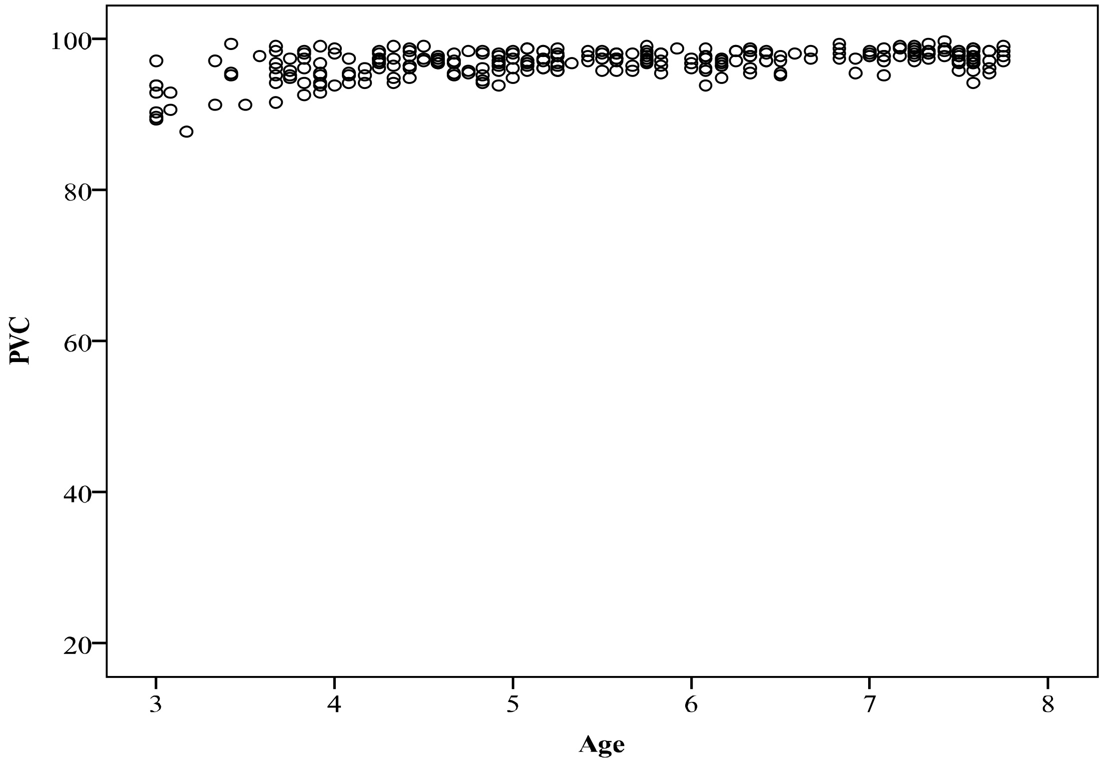


Figure 6.7: PCCC Compared with the Age of Individual Children (n = 264)

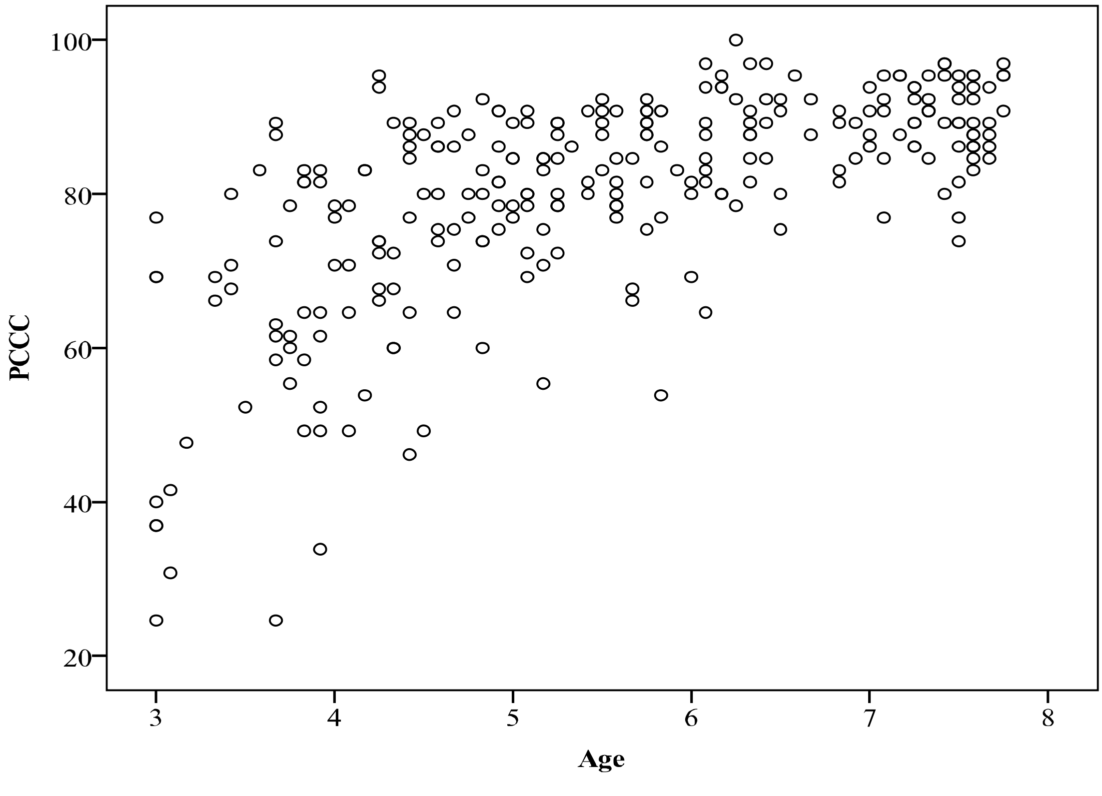
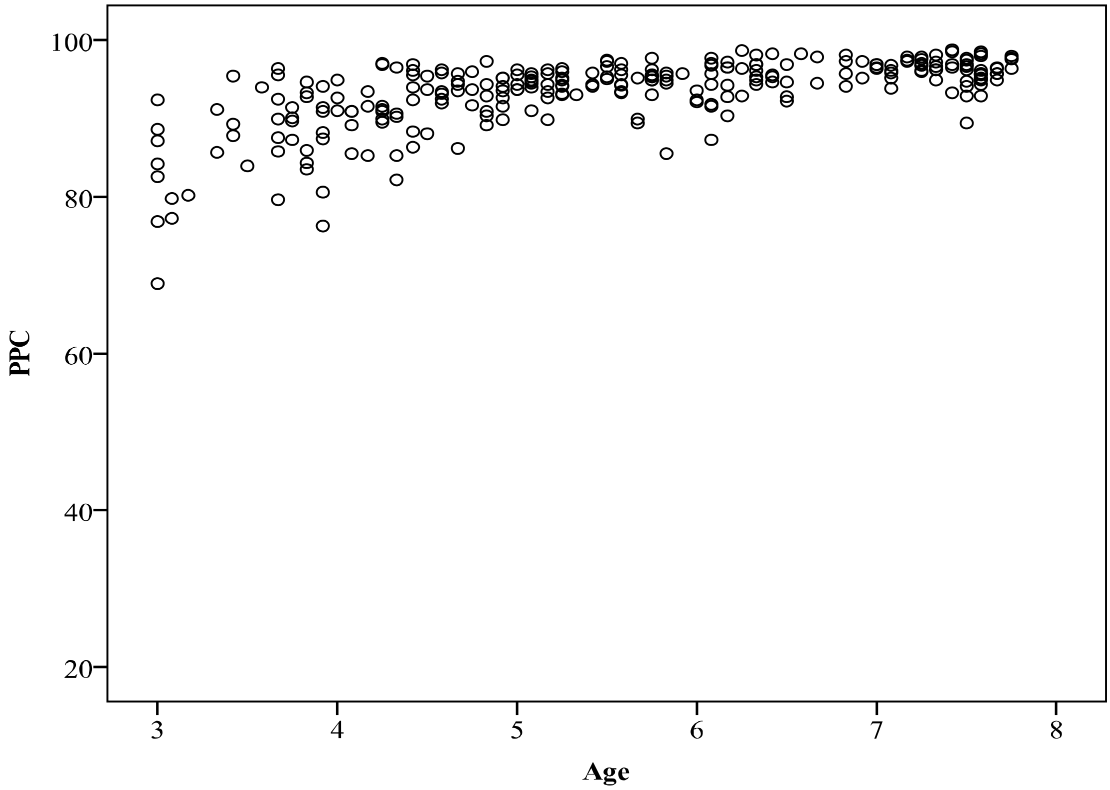


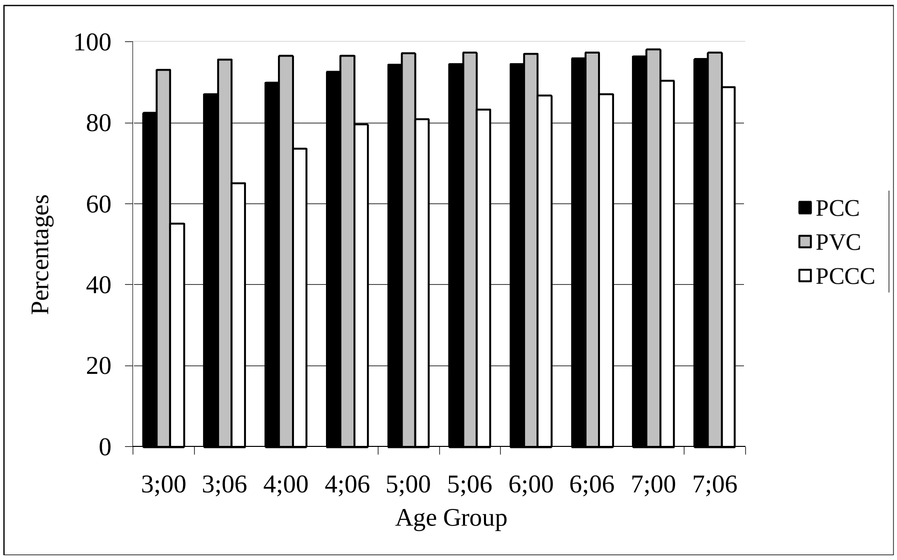
Figure 6.8: PPC Compared with the Age of Individual Children (n = 264)



6.2.4 Comparison of PCC, PVC and PCCC across Different Age Groups

Figure 6.9 shows the comparison of three measures PCC, PVC and PCCC across the ten age groups. Because there was no significant difference between the results according to sex, the female and male results are combined in Figure 6.9. Children had higher PVC than PCC and PCCC across all the age groups. PCCC was lower than both PVC and PCC in each age group. Thus, children's overall speech sound accuracy was predominantly carried by vowels, followed by consonants and then consonant clusters. Each of these measures reached at least 90% accuracy by the age of 7 years. The high accuracy of vowels is commonly reported in many studies. For examples, Templin (1957), Pollock (2002) and Dodd et al. (2003) found that PVC was high (over 90%) for children as young as 3 years of age. An age ceiling effect was thus noted in these young children. Therefore, the high accuracy of vowel production in comparison to consonants and consonant clusters was to be expected.

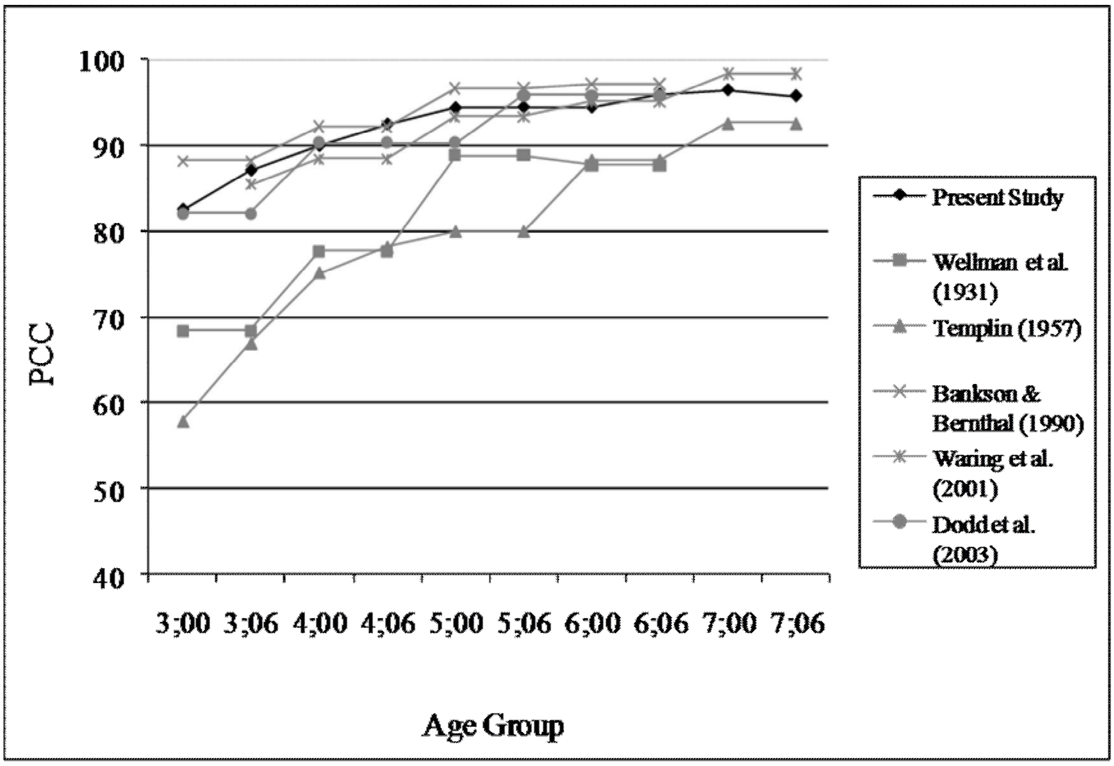
Figure 6.9: Comparison of PCC, PVC and PCCC Values across the Age Range of 3 to 7 Years



6.2.5 Comparison of PCC, PVC and PCCC in MalE and SE

The PCC, PVC and PCCC values in MalE were compared with SE as shown in Figures 6.10, 6.11 and 6.12, respectively. PCC in MalE was comparable with previous SE studies such as Bankson and Bernthal (1990), Waring et al. (2001) and Dodd et al. (2003). However, it was higher than Wellman et al. (1931) and Templin (1957) which were consistently lower than the other SE studies. The PVC values for MalE were similar to Templin (1957) up to 6 years of age, after which PVC was slightly lower than Templin (1957). The PVC values in MalE were consistently lower than Pollock (2002) and Dodd et al. (2003), although the difference was not very great. PVC in MalE was higher than Wellman et al.'s study (1931) in which PVC was consistently lower than other SE studies. PCCC in MalE was both similar and different to SE. PCCC in MalE was similar to Wellman et al. (1931) and Templin (1957). The PCCC values reported by Waring et al. (2001) were consistently higher than the present and previous studies. In sum, PCC, PVC and PCCC in MalE showed both similarities and differences to SE. Possible reasons for these discrepancies will be explored in the discussion section of this chapter.

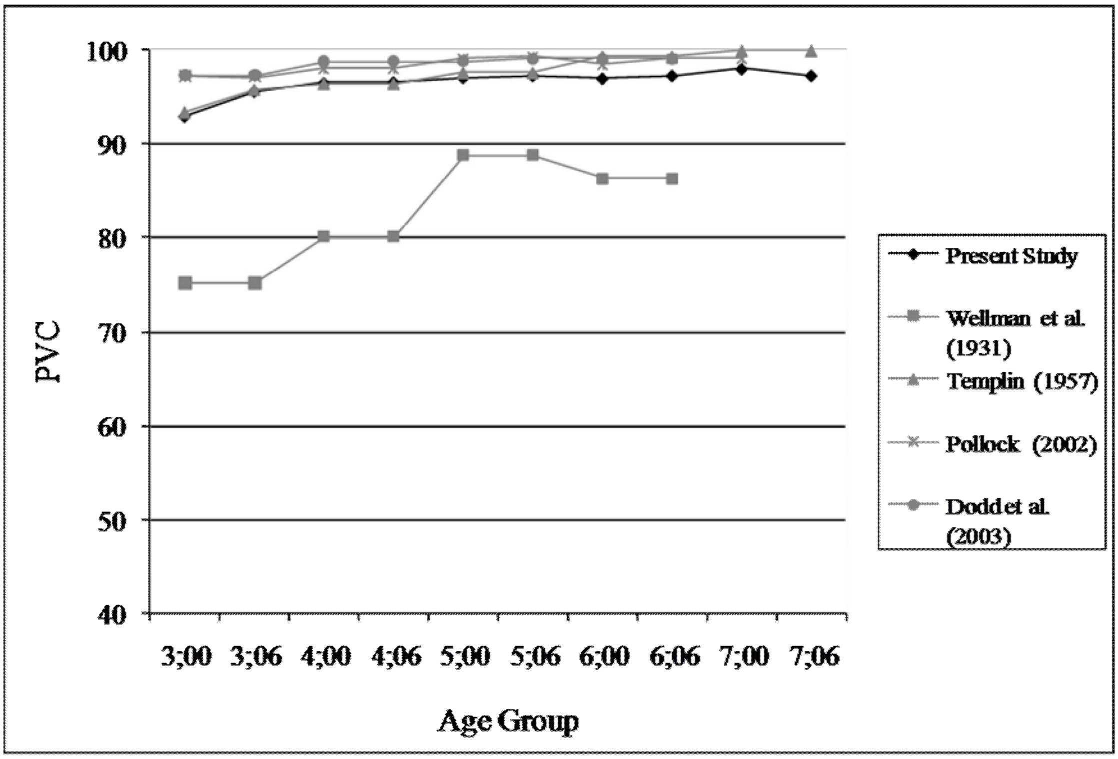
Figure 6.10: Comparison of PCC Values Obtained from the Present Group of MalE speaking Children in Comparison to Previous Studies of SE speaking Children



Notes:

- The present study considered PCC at half year age intervals; Wellman et al. (1931), Bankson & Bernthal (1990), Waring et al. (2001) considered PCC at 1 year age intervals; Templin (1957) considered PCC at half year age intervals until 4 years old then 1 year age intervals for older children and Dodd et al. (2003) considered PCC at 1 year intervals for 3 years old and 1 ½ year intervals for children age 4 years and older.
- Where studies considered PCC at yearly intervals, the same value was given for each 6 monthly point within the year.
- Results from the present study took MalE dialectal features into consideration.

Figure 6.11: Comparison of PVC Values Obtained from the Present Group of MalE speaking Children in Comparison to Previous Studies of SE speaking Children



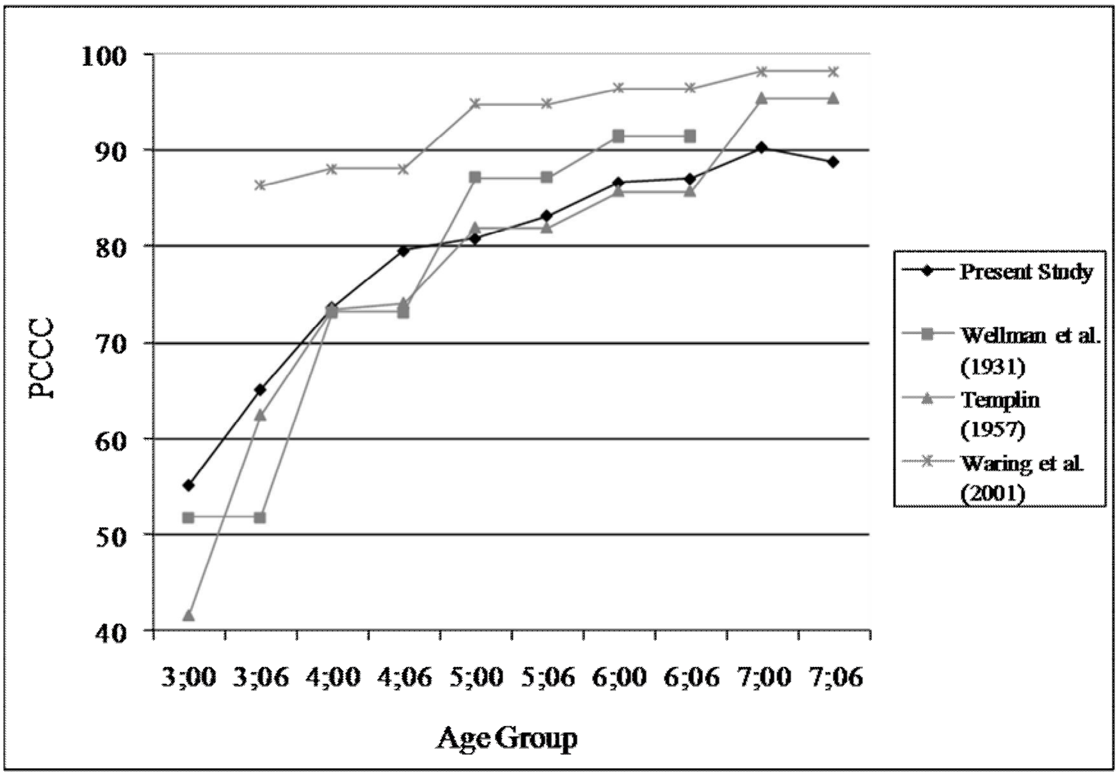
Notes:

- The present study and Pollock (2002) considered PVC at half year age intervals; Wellman et al. (1931) considered PVC at 1 year age intervals; Templin (1957) considered PVC at half year age intervals until 4 years old then 1 year age interval for older children and Dodd et al. (2003) considered PVC at 1 year intervals for 3 years old and 1 ½ year old intervals for children age 4 years and older.

- Where studies considered PVC at yearly intervals, the same value was given for each 6 monthly point within the year.

- Results from the present study took MalE dialectal features into consideration.

Figure 6.12: Comparison of PCCC Values Obtained from the Present Group of MalE speaking Children in Comparison to Previous Studies of SE speaking Children



Notes:

- The present study considered PCC at half year age intervals; Wellman et al. (1931) and Waring et al. (2001) considered PCC at 1 year age intervals; Templin (1957) considered PCC at half year age intervals until 4 years old then 1 year age intervals for older children.
- Where studies considered PCCC at yearly intervals, the same value was given for each 6 monthly point within the year.
- Results from the present study took MalE dialectal features into consideration.

6.2.6 Consonant Accuracy according to Sound Class

Consonant accuracy was calculated according to six sound classes based on manner of articulation: affricates, fricatives, liquids, stops, nasals and glides. Mean percentages and standard deviations are shown in Table 6.3. The older children produced consonants more accurately than the younger children in all sound classes. The order of consonant accuracy for all children according to sound classes from low to high was: affricates, fricatives, liquids, stops, nasals and glides. Therefore, affricates and glides were respectively the most difficult and the easiest sounds to be acquired by MalE speaking children.

Table 6.3: Mean Percentage of Consonants Produced Accurately according to Sound Class. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Sound Classes					
	Affricates	Fricatives	Liquids	Stops	Nasals	Glides
3;00-3;05	66.67 (21.60)	74.74 (18.03)	84.20 (10.88)	86.42 (6.96)	88.21 (5.92)	88.00 (11.46)
3;06-3;11	79.04 (16.13)	81.94 (14.36)	89.55 (10.27)	88.77 (6.57)	91.01 (4.76)	93.46 (6.29)
4;00-4;05	83.79 (16.94)	87.95 (6.89)	88.68 (14.79)	91.87 (5.48)	91.14 (8.55)	93.79 (7.28)
4;06-4;11	85.33 (11.89)	89.33 (7.02)	94.20 (5.46)	94.06 (2.98)	94.36 (3.75)	96.67 (6.06)
5;00-5;05	89.33 (10.48)	91.44 (3.55)	94.57 (4.07)	95.67 (1.89)	96.97 (2.90)	96.00 (6.21)
5;06-5;11	85.00 (12.03)	93.05 (6.09)	95.00 (4.95)	95.57 (2.68)	96.51 (3.52)	97.00 (5.35)
6;00-6;05	87.74 (12.17)	92.05 (5.71)	95.09 (5.29)	96.21 (2.30)	95.98 (3.19)	96.13 (5.58)
6;06-6;11	93.08 (8.55)	94.09 (4.33)	93.98 (10.84)	97.42 (1.75)	97.63 (2.32)	97.69 (4.39)
7;00-7;05	91.00 (9.14)	94.04 (2.46)	97.25 (3.42)	97.76 (1.88)	97.90 (2.08)	99.67 (1.83)
7;06-7;11	91.83 (8.66)	93.05 (3.69)	95.00 (9.72)	97.49 (1.70)	97.54 (2.51)	99.00 (4.03)
Total	**85.28 (12.76)**	**89.17 (7.21)**	**92.75 (7.97)**	**94.12 (3.42)**	**94.72 (3.95)**	**95.74 (5.85)**

6.2.7 Consonant Accuracy according to Syllable Position

Speech sound accuracy for consonants was compared in syllable initial (SI) and syllable final (SF) positions. Mean percentages of consonants produced accurately according to syllable position between 3 to 7 years of age are shown in Table 6.4. Consonant accuracy in SI was consistently higher than in SF across all age groups. A paired *t*-test was performed to examine whether the differences between consonant accuracy in SI and SF was significant across individual children. Children were treated as individuals for this calculation, and not collapsed into age groups. The results indicated that consonant accuracy in SI (*M* = 93.61, *SD* = 5.89) was significantly higher than SF (*M* = 91.10, *SD* = 6.13); *t* (263) = 8.794, *p* < 0.0001.

Table 6.4: Mean Percentage of Consonants Produced Accurately according to Syllable Position. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Syllable Position	
	SI	SF
3;00-3;05	82.78 (10.41)	81.82 (7.65)
3;06-3;11	87.94 (7.89)	85.41 (7.22)
4;00-4;05	90.91 (5.39)	88.00 (6.52)
4;06-4;11	93.70 (3.42)	90.11 (4.43)
5;00-5;05	94.83 (1.96)	93.36 (3.10)
5;06-5;11	95.49 (2.96)	92.45 (5.45)
6;00-6;05	95.20 (3.26)	93.10 (3.96)
6;06-6;11	96.52 (2.78)	94.79 (3.50)
7;00-7;05	97.53 (1.44)	94.24 (3.28)
7;06-7;11	96.53 (2.62)	94.27 (3.66)
Total	**93.61 (5.89)**	**91.10 6.13)**

6.2.8 Consonant Accuracy on Shared and Unshared Sounds

The distinction between consonant accuracy for shared and unshared sounds was examined. Sounds were considered shared if they occurred in English, Mandarin Chinese and Malay. Sounds were considered unshared if they only occurred in English (refer to Chapter 1). Mean percentages and standard deviations of consonants according to shared and unshared sounds in SI and SF are shown in Table 6.5. Consonant accuracy on shared sounds was consistently higher than unshared sounds across all age groups in both SI and SF. To determine if the difference between shared and unshared sound production was significantly different, a paired *t*-test was performed. The results demonstrated that accuracy on shared sounds in SI (*M* = 94.64, *SD* = 5.32) was significantly higher than unshared sounds in SI (*M* = 86.24, *SD* = 12.48); *t* (263) = -14.724, *p* < 0.0001 across individual children. Similarly, the results indicated that accuracy on shared sounds in SF (*M* = 94.64, *SD* = 5.28) was significantly higher than unshared sounds in SF (*M* = 87.26, *SD* = 8.49); *t* (263) = -17.652, *p* < 0.0001.

Table 6.5: Mean Percentage of Consonants Produced Accurately according to Shared and Unshared Sounds in Syllable-initial and Syllable-final Positions. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Syllable-Initial		Syllable-Final	
	Shared	Unshared	Shared	Unshared
3;00-3;05	85.16 (9.32)	65.81 (21.08)	87.94 (7.02)	75.17 (9.64)
3;06-3;11	89.66 (7.32)	75.68 (15.54)	90.29 (5.28)	80.11 (10.59)
4;00-4;05	92.10 (5.12)	82.42 (12.06)	91.84 (7.75)	83.83 (8.29)
4;06-4;11	94.83 (3.12)	85.70 (9.07)	93.65 (3.91)	86.26 (6.52)
5;00-5;05	95.85 (1.95)	87.53 (7.27)	96.56 (3.51)	89.89 (4.66)
5;06-5;11	96.20 (2.68)	90.43 (7.65)	96.19 (4.82)	88.39 (7.38)
6;00-6;05	96.25 (2.65)	87.72 (10.15)	95.65 (3.09)	90.32 (6.32)
6;06-6;11	97.04 (2.79)	92.80 (8.95)	97.19 (2.68)	92.18 (5.30)
7;00-7;05	97.95 (1.46)	94.52 (4.25)	97.35 (1.88)	90.86 (6.53)
7;06-7;11	97.21 (2.68)	91.72 (4.77)	97.09 (2.61)	91.21 (6.23)
Total	**94.64 (5.32)**	**86.24 (12.48)**	**94.64 (5.28)**	**87.26 (8.49)**

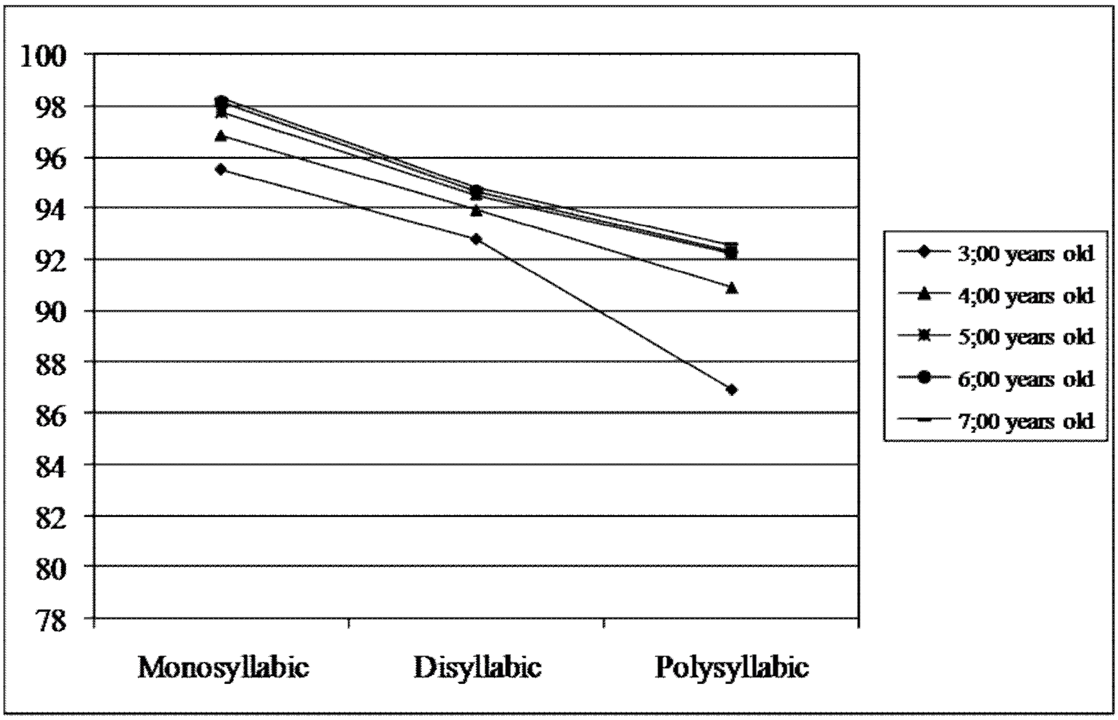
6.2.9 Vowel Accuracy According to Syllable Type

Table 6.6 shows the mean percentages and standard deviations for vowel accuracy according to syllable type. The younger children had lower percentages of vowel accuracy than the older children. The overall total mean percentages of vowel accuracy for monosyllabic words (MSWs) were higher compared to disyllabic words (DSWs) and polysyllabic words (PSWs). The total mean percentages of vowel accuracy for DSWs were higher than PSWs. The mean percentages of vowel accuracy for MSWs, DSWs and PSWs for each age group in one year intervals are displayed in Figure 6.13.

Table 6.6: Mean Percentage of Vowels Produced Accurately according to Syllable Type. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Syllable Types		
	MSWs	DSWs	PSWs
3;00-3;05	94.20 (2.80)	92.01 (3.12)	83.94 (6.99)
3;06-3;11	96.29 (1.91)	93.23 (2.75)	88.64 (4.33)
Total	**95.52 (2.46)**	**92.78 (2.91)**	**86.92 (5.84)**
4;00-4;05	96.82 (2.02)	93.89 (2.20)	90.11 (3.91)
4;06-4;11	96.84 (1.82)	93.92 (1.69)	91.62 (3.34)
Total	**96.83 (1.90)**	**93.91 (1.94)**	**90.88 (3.68)**
5;00-5;05	97.65 (1.39)	94.55 (1.91)	91.94 (2.83)
5;06-5;11	97.86 (1.74)	94.48 (1.64)	92.60 (2.30)
Total	**97.75 (1.56)**	**94.51 (1.77)**	**92.27 (2.58)**
6;00-6;05	97.92 (2.00)	94.66 (1.80)	92.14 (2.37)
6;06-6;11	98.66 (1.53)	94.63 (1.85)	92.67 (2.11)
Total	**98.14 (1.89)**	**94.65 (1.79)**	**92.29 (2.29)**
7;00-7;05	98.32 (1.21)	95.28 (1.54)	93.17 (2.06)
7;06-7;11	98.26 (1.27)	94.27 (2.13)	91.97 (2.06)
Total	**98.29 (1.23)**	**94.77 (1.91)**	**92.57 (2.13)**
OVERALL TOTAL	**97.39 (2.03)**	**94.19 (2.15)**	**91.20 (3.91)**

Figure 6.13: Mean Percentage of Vowels Produced Accurately for Monosyllabic, Disyllabic and Polysyllabic Words across the 3 to 7 Age Period



A two-way ANOVA with repeated measures showed an age group effect F $(9,254) = 17.68$, $p < 0.001$, a syllable number effect F $(2,254) = 511.09$, $p < 0.001$ and an interaction effect F $(18, 254) = 4.02$, $p < 0.001$ on mean PVC. Post hoc analysis using a Tukey test ($p < 0.05$) for the between-subject variable of age indicated that all the pair-wise comparisons were significant. The effect of different age groups depended on what level of syllable number was present. The results indicated significant differences between the children in the following groups:

In MSWs,

- 3;00-3;05 year old children were significantly different from other children except 3;06-3;11 year old children.

In DSWs,

- 3;00-3;05 year old children were significantly different from 6;00-6;05 and 7;00-7;05 year old children.

In PSWs,

- 3;00-3;05 year old children were significantly different from 3;06-7;11 year old children;
- 3;06-3;11 year old children were significant different from 4;06-7;11 year old children
- 4;00-4;05 year old children were significantly different from 7;00-7;05 year old children.

Post hoc testing of the number of syllables indicated that all pair-wise comparisons were significant for the group as a whole. There were significant differences between all possible syllable type comparisons. Post hoc analysis of the syllable number effect using a Tukey test ($p < 0.05$) indicated there were significant syllable number effects for each of the syllable type comparisons, except 6;06-6;11 year old children where the DSWs and PSWs were not significantly different.

6.2.10 Consonant Cluster Accuracy according to Syllable Position

Two-element consonant clusters were compared in SI and SF. Final clusters which contained morphological information such as past tense and plural markers were not included in the present calculation. Mean percentages and standard deviations of consonant cluster accuracy according to syllable position from 3 to 7 years old are shown in Table 6.7. Syllable-final consonant clusters were consistently produced more accurately than syllable-initial consonant clusters for 3 and 4 year old children. However, after 4 years old, children exhibited more correct productions of syllable-initial consonant clusters in comparison to syllable-final consonant clusters. Paired *t*-tests were performed to examine the differences in consonant cluster accuracy in these two groups of children. The first paired *t*-test was performed on 3;00-4;11 year old children. The results indicated that consonant cluster accuracy in SI (M = 71.95, SD = 19.57) was significantly lower than SF (M = 80.78, SD = 12.67); t (100) = -5.830, $p <$ 0.0001 across individual children within these age groups. In contrast, the results of a second paired *t*-test that was performed on 5;00-7;11 year old children indicated that consonant cluster accuracy in SI (M = 91.14, SD = 8.52) was significantly higher than SF (M = 87.47, SD = 8.61); t (164) = 4.953, $p <$ 0.0001 across individual children within these age groups.

Table 6.7: Mean Percentage of Consonant Clusters Produced Accurately according to Syllable Position. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Syllable Position	
	SI	SF
3;00-3;05	50.57 (21.79)	75.56 (15.26)
3;06-3;11	64.17 (18.40)	78.42 (14.93)
4;00-4;05	76.79 (13.51)	81.42 (11.62)
4;06-4;11	84.72 (11.28)	84.81 (8.75)
5;00-5;05	85.69 (9.67)	83.98 (8.67)
5;06-5;11	88.54 (11.06)	84.63 (7.81)
6;00-6;05	91.90 (7.46)	86.74 (9.26)
6;06-6;11	90.43 (6.56)	91.45 (6.26)
7;00-7;05	95.45 (4.91)	91.11 (7.09)
7;06-7;11	94.39 (4.88)	89.26 (8.87)
Total	**83.87 (16.61)**	**84.93 (10.81)**

6.2.11 Consonant Cluster Accuracy according to Category

The accuracy of consonant clusters was compared across different cluster categories based on cluster features. The mean accuracy for production of these clusters across age groups is shown in Table 6.8. The older children performed more accurately than the younger children on all cluster categories. The high standard deviations indicated high individual variability in cluster production. The overall order of consonant cluster accuracy according to cluster categories from high to low was: /s/ + C, C + /w/, C + /j/, C + /l/ and C + /r/. However, the overall percentages of accuracy for /s/ + C clusters, C + /w/ clusters and C + /j/ clusters were very similar. The 3 year old children demonstrated more correct productions of C + /j/ clusters and C + /w/ clusters than /s/ + C clusters. The 4 year old children exhibited more correct productions of /s/ + C clusters than C + /j/ clusters and C + /w/ clusters. The productions of C + /l/ clusters and C + /r/ clusters were consistently less accurate than the other clusters until 5 years old. The accuracy of all types of clusters except C + /j/ clusters was more than 90% among the 7 year old children.

Table 6.8: Mean Percentage of Consonant Clusters Produced Accurately according to Cluster Category. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Types of Cluster Category				
	/s/ + C	C + /w/	C + /j/	C + /l/	C + /r/
3;00-3;05	59.05 (36.57)	66.67 (36.19)	74.44 (20.77)	42.00 (27.57)	41.25 (25.09)
3;06-3;11	68.68 (36.04)	88.46 (21.48)	86.54 (15.65)	63.08 (24.46)	51.44 (24.45)
4;00-4;05	91.13 (18.86)	81.03 (28.07)	86.78 (11.25)	72.41 (23.40)	68.97 (19.87)
4;06-4;11	91.90 (18.26)	88.33 (21.51)	85.63 (13.89)	85.81 (14.78)	78.78 (17.42)
5;00-5;05	97.14 (7.87)	89.66 (20.61)	95.56 (7.50)	81.38 (17.26)	82.92 (14.95)
5;06-5;11	94.76 (12.15)	85.00 (23.30)	90.32 (12.00)	85.81 (14.55)	85.21 (17.17)
6;00-6;05	96.77 (8.81)	95.16 (15.03)	92.31 (11.00)	93.23 (8.32)	89.11 (14.79)
6;06-6;11	95.60 (9.01)	84.62 (24.02)	90.23 (9.47)	*83.08 (25.94)	92.79 (5.62)
7;00-7;05	99.05 (3.62)	98.28 (9.28)	90.56 (8.40)	94.83 (7.38)	95.83 (10.42)
7;06-7;11	98.57 (4.36)	96.67 (12.69)	88.57 (12.79)	92.90 (9.38)	94.79 (8.38)
Total	**90.91 (21.16)**	**88.83 (22.19)**	**88.57 (12.79)**	**81.74 (21.87)**	**79.73 (22.90)**

* The noticeable decrease of C + /l/ cluster was largely due to one child who consistently failed to produce /l/ accurately.

6.2.12 Consonant Cluster Accuracy according to Number of Constituents

Syllable-initial consonant clusters were divided into those consisting of two and three constituents. Older children demonstrated more correct productions than younger children in both types of clusters as shown in Table 6.9. Two-element clusters consistently had higher accuracy and lower standard deviations than three-element clusters across the age groups. Two-element clusters reached 90% accuracy at age 6 years. The accuracy of three-element clusters was low even in the upper limit of the age groups. In order to examine the differences of consonant cluster accuracy in two and three constituent clusters; a paired *t*-test was performed across all children individually. The results indicated that consonant accuracy in two-element clusters (M = 83.87, SD = 16.62) was significantly higher than three-element clusters (M = 52.21, SD = 24.28); t (263) = 29.254, p < 0.0001, implying that three-element clusters were more difficult than two-element clusters.

Table 6.9: Mean Percentage of Consonant Clusters Produced Accurately according to Number of Constituents. The Corresponding Standard Deviations are Shown in Parentheses

Age Group	Number of Constituents	
	Two	Three
3;00-3;05	50.57 (21.79)	25.56 (24.29)
3;06-3;11	64.17 (18.40)	32.05 (24.91)
4;00-4;05	76.79 (13.51)	44.25 (24.51)
4;06-4;11	84.72 (11.28)	43.89 (21.21)
5;00-5;05	85.69 (9.67)	54.44 (19.04)
5;06-5;11	88.54 (11.06)	52.22 (18.94)
6;00-6;05	91.90 (7.46)	62.37 (23.16)
6;06-6;11	90.43 (6.56)	66.67 (16.67)
7;00-7;05	95.45 (4.91)	70.00 (16.61)
7;06-7;11	94.39 (4.88)	62.22 (18.01)
Total	**83.87 (16.61)**	**52.21 (24.28)**

6.3 DISCUSSION

6.3.1 The Effect of MalE Dialectal Features

Speech sound accuracy of the present group of MalE speaking children differed greatly when MalE dialectal features were not considered. The results of the present study revealed that their speech sound accuracy was underestimated when MalE dialectal features were not considered. Speech sound accuracy was significantly lower for all age groups when MalE dialectal features were not considered. For example, PCC values with and without MalE dialectal consideration for 3 to 7 year old children were between 82.5% - 95.8% and 65.3% - 76.5%, respectively. According to Shriberg & Kwiatkowski's (1982) four levels of severity of involvement based on PCC, a value of 85% is determined to be an appropriate cut-off point to distinguish normal speech or mild involvement. A mild-moderate impairment is 65%-85%. A moderate-severe impairment is 50%-65% and a severe impairment is less than 50%. When MalE dialectal features were not considered in the calculation of PCC of MalE, all typically developing MalE speaking children between the ages of 3 to 7 years would be regarded as having mild-moderate speech impairment because their PCC fell into the range of 65.3% to 76.5%. Typically developing MalE children would be penalized for a speech difference resulting from MalE dialectal variation rather than a true speech disorder. A similar condition was noted by Cole & Taylor (1990) for AAVE, where over half of the children were misdiagnosed with a phonological disorder when the effect of dialect is not considered. Likewise, 74% of Spanish-speaking children in Goldstein and Iglesias's (2001) study were characterized with mild-moderate phonological disorder if dialectal features of Spanish were not considered.

The failure to account for dialectal features in speech sound production results in a number of consequences in the assessment and treatment of phonology. First, there might be a shift in terms of diagnosis, where typically developing children could be diagnosed as having phonological disorders as evident in the present study. Second, the severity classification of children's phonological status might change. For example, Washington and Craig (1992) found that three AAVE speaking children's severity level in their study altered from severe to moderate after AAVE features were considered. Goldstein and Iglesias (2001) found all 54 Spanish-speaking children with phonological disorders shifted to a lesser level of severity after Spanish dialectal features were taken into consideration. Third, unnecessary intervention or treatment might be targeted for dialectal phonological features resulting from inaccurate diagnosis and severity classification. A consideration of the dialectal features of MalE is, therefore, crucial when assessing MalE speaking children in order to avoid these undesired consequences. SLPs in Malaysia are urged to consider dialectal features when scoring phonological assessments of MalE speaking children.

6.3.2 The Effects of Age, Sex and Individual Differences

As might be expected, the accuracy of speech sound production was found to be higher in the older MalE speaking children. Speech sound accuracy increased as age increased. A gradual progression of speech sound accuracy was evident in the present study, demonstrating development toward a full phonological system. For PCC, the development of consonants is still taking place for children between 3;00 and 4;05 years old. However, ceiling effects were noticed for children aged 4;06 years or older. Ceiling effects meant that children within this age range did not differ in consonant accuracy. Therefore, MalE speaking children have adult-like pronunciation of consonants as young as 4;06. For PVC, only children between 3;00 and 3;11 years of age were significantly different from the other age groups, implying the development of vowels is complete before 4 years of age. For PCCC, significant differences were still observed for 5 and 7 year old children, indicating that consonant cluster development continues in older children.

The present study found that sex did not exert an influence on children's accuracy of speech sound production. There are a number of studies which support this suggestion. For example, Burt, Holm, & Dodd (1999) found no sex effect in the consistency of speech production of 4 year old British children; Waring et al. (2001) found no significant differences between the number of correct speech productions for Australian boys and girls aged between 3 ½ and 7 years. Nonetheless, the findings of these studies and the present study were substantially different from other studies. Many studies report that females have better speech production than males. Hyde & Linn (1988) found that sex accounted for 10-15% of the variance in the area of speech production when applying meta-analysis techniques to over 170 studies. Similarly, Kenney & Prather (1986) found that males exhibited more variance in their speech production than females in their study of sex variability in the speech production of 3 to 5 year old children and proposed that females have greater speech production ability than males.

Sex differences have also been reported in large scale normative studies of speech sound production, but these differences are usually significant only in particular age groups. For example, Wellman et al. (1931) found that consonant accuracy was significantly different for 3 and 4 year old females and males, with females showing higher accuracy of consonant production than males, but no significant difference was found between 5 and 6 year old females and males. Poole (1934) found no sex differences in the speech production of younger age groups (between 2;06 and 5;06 years old). However, sex differences were significant for children older than 5;06 years old, with females showing superior phonological ability than males. Smit et al. (1990) found that a sex differences was only apparent in children at the ages of 4;00, 4;06 and 6;00 years. Dodd et al. (2003) found no significant sex difference for younger children between 3;00 and 5;05 years of age. However, sex differences were found between 5;06 and 7;00 years, with better phonological accuracy among females. When the performance of females and males is compared over an age range in the studies mentioned above, females tend to exhibit higher rates of accuracy more frequently than males. However, the differences are not consistent and are only infrequently statistically significant. Therefore, the suggestion of sex differences in speech sound development remains controversial.

Individual variability occurs when different children of the same age or stage of development have different realizations for particular speech sounds (McLeod & Hewett, 2008). The present findings showed that younger children were highly variable in terms of speech sound production. Among the speech sounds sampled, consonant clusters were the most variable. Therefore, an understanding of both the general trends and the range of individual variability is crucial in order to gauge the amount of time an individual child will need to achieve certain phonological skills (Stoel-Gammon, 1991). McLeod & Hewett (2008) emphasized that when high variability is found in typically developing children, identification of children with speech disorders must not be based on rigid criteria of group trends or data. Therefore, caution must be exercised when interpreting the speech performance of young children, especially for the production of consonant clusters.

6.3.3 Comparison of Speech Sound Accuracy in MalE and SE

Speech sound accuracy (PCC, PVC and PCCC) with MalE dialectal consideration in the present study showed more similarities than differences when compared to earlier studies on SE. The specific differences in findings were largely due to methodological differences.

PCC in MalE was comparable with major recent SE studies such as Bankson and Bernthal (1990), Waring et al. (2001) and Dodd et al. (2003). However, it was higher than Wellman et al. (1931) and Templin (1957). The possible reason for the discrepancies found in Wellman et al. and Templin compared with other studies might be due to differences in the definitions of response adequacy in considering the acceptable responses. The definitions of response adequacy may have changed over the years since Wellman et al. and Templin started on the investigation of speech sound development many years ago. For example, the /t/ sound was acquired very late in Templin's study due to high error rate in medial /t/. Smit (1986) felt that Templin might have defined a voiceless aspirated /t/ as an adequate response, therefore, a flapped /t/ or [ɾ], would be regarded as incorrect. A flapped /t/ is now commonly regarded as a dialectal variant and would not have been penalized in the recent normative studies. More dialectal variants are considered in recent studies. For example, vocalization of /l/ was included as acceptable responses in Dodd et al.'s (2003) study. If dialectal variants were not considered in the studies by Wellman et al. and Templin, it is not surprising that children's accuracy of consonants was consistently lower than in other SE studies.

PVC in MalE was slightly lower than Pollock (2002) and Dodd et al. (2003) for all age groups as well for children age 6 years or older in Templin's (1957) study. The potential reason for this discrepancy is the inclusion of PSWs in the present study. In the present study, vowels were sampled in MSWs, DSWs and PSWs, while previous studies such as Dodd et al., Pollock and Templin were dominated by MSWs or DSWs. James, van Doorn & Mcleod (2001) found that PVC derived from a corpus of words that contained more PSWs in addition to MSWs or DSWs was significantly lower than those studies dominated by MSWs or DSWs. Therefore, the inclusion of PSWs will be likely to reduce the accuracy of vowel production in the present study.

PCCC in MalE was compared to Wellman et al. (1931), Templin (1957) and Waring et al. (2001). Variation was observed in PCCC within SE. For instance, at age 3;06 years, PCCC was 51.8% in Wellman et al., 62.5% in Templin and 86.4% in Waring et al.. One of the possible causes that could lead to this great variation might be the numbers and types of clusters sampled. Wellman et al. sampled 42 two-element clusters and 5 three-element clusters; Templin sampled 71 two-element clusters and 19 three-element clusters and Waring et al. targeted 27 consonant blends without providing details of types of consonant clusters. Templin included many final two-element /r/ clusters and final three-element clusters which probably caused PCCC in his study to be lower than in the others. The results for PCCC in MalE were more similar to Wellman et al. and Templin than Waring et al.. However, PCCC in MalE was lower in comparison to Templin when children reached 7 years old, which was also the upper age limit of the present study. It is uncertain whether ceiling effects have been reached at this age or whether PCCC in MalE will continue to increase after this age. Therefore, the inclusion of children older than 7 years old might be able to clarify this question. PCCC in Waring et al.'s study was higher than the other studies all the time. This is probably because Waring et al. excluded children with articulation problems in their normative study, and thus the reference group was not normally distributed. The exclusion of children with articulation problems might lead to higher PCCC because children with articulation problems are reported to have particular difficulty producing consonant clusters (Hodson & Paden, 1981; Khan, 1982; Mcleod, van Doorn, & Reed, 1997; Shriberg & Kwiatkowski, 1980; Young, 1987). Another possible reason for higher PCCC in Waring et al.'s study is that the majority of children were from two-parent families consisting of tertiary educated, professional or managerial adults. Many research findings report that speech development is affected by socio-economic status (SES). Templin, for instance found that high SES children performed significantly better than low SES children in speech sound acquisition. Therefore, higher PCCC exhibited by children in Waring et al.'s study might be due to inclusion of children from higher SES.

6.3.4 Consonant Accuracy by Sound Class

The order of MalE consonant accuracy according to sound class from low to high was: affricates, fricatives, liquids, stops, nasals and glides. The high percentage of accuracy in stops, nasals and glides was consistent with many SE studies (Austin & Shriberg, 1997; Shriberg, 1993; Smit, et al., 1990). However, the order of production accuracy for affricates, fricatives and liquids was dissimilar to SE studies. In the present study, liquids had a higher accuracy than fricatives and affricates. Affricates had the lowest percentage of accuracy among all the sound classes. Shriberg found that liquids and most of the fricatives were acquired later compared to affricates. Similarly, Austin & Shriberg reported that consonant accuracy of affricates (79.4%) was higher than fricatives (74.2%) and liquids (65.2%). Smit et al. (1990) showed that affricates (83.2%) and fricatives (80.5%) were more accurate than liquids (73.5%).

In contrast, many studies of bilingual speakers of English demonstrate similar findings to the present study. Liquids have higher accuracy than fricatives and affricates. Fabiano-Smith & Goldstein (2010) found that monolingual English speakers produced more correct fricatives and affricates than liquids. However, bilingual

Spanish-English speakers produced more correct liquids than fricatives. Likewise, Goldstein and Washington (2001) reported that the accuracy rate of consonants was higher for liquids (94.9%) than for fricatives (83.9%) and affricates (88.9%) in Spanish-English bilingual children. Goldstein, Fabiano, & Washington (2005) also found that liquids (92.7%) were more accurate than fricatives (92.4%) and affricates (86.7%) in their study of the phonological skills of five Spanish-English bilingual children. Higher accuracy of liquids was also reported in AAVE. Liquid errors were less in 4 and 5 year old AAVE speaking children (4.5%) in comparison to SE speaking children (8.7%) (Seymour & Seymour, 1981). It is possible that MalE and AAVE speaking children as well as Spanish-English bilingual children demonstrated different acquisition patterns than monolingual SE speaking children, because of cross-linguistic effects.

Liquid production accuracy could be higher in MalE because syllable-initial liquids in English are shared between Mandarin Chinese and Malay, which could accelerate the acquisition process of the /l/ and /r/ sounds. The same reason might apply to AAVE and Spanish-influenced English as liquids are shared between English and AAVE or Spanish phonological systems. The consideration of the MalE variants in liquid production (omission and vocalization of postvocalic /l/) also increased the accuracy of liquid production compared to SE such as American English which expects children to retain postvocalic /l/ and /r/. Affricates may be regarded as more difficult consonants by MalE speaking children in comparison to liquids because affricates in SF are not shared in the phonological system of either Mandarin Chinese or Malay. MalE speaking children are likely to find them difficult to produce syllable-finally and thus lower percentage accuracy will be obtained.

6.3.5 Consonant Accuracy by Syllable Position

Accuracy of syllable-initial consonants in MalE was consistently higher than syllable-final consonants across all age groups. Previous studies such as Wellman et al. (1931) and Templin (1957) also showed significant differences in consonant accuracy across three word positions: initial, medial and final. Consonant accuracy in initial position was higher than both medial and final positions, and medial position (SIWW and SFWW) was higher than final position in both studies.

The results of the present study agree with Wellman et al. (1931) and Templin (1957). The possible reasons why MalE children performed better in production of consonants in SI than in SF might be the influence of Mandarin Chinese and Malay. Mandarin Chinese and Malay only permit a small number of final consonants, leading to potential difficulty in mastering segmental and phonotactic aspects of English syllable-finally. Therefore, the findings of the present study reinforce the importance of considering syllable or word position when assessing the speech sound production of MalE speaking children.

6.3.6 Consonant Accuracy by Phonetic Similarity

According to the hypothesis of phonetic similarity (Flege, 1981, 1987), the acquisition of MalE consonants will be affected by the phonological systems of Mandarin Chinese and Malay. Phonetically similar sounds should aid in the rate of MalE consonant acquisition. Fabiano-Smith & Goldstein (2010) found that bilingual speakers of Spanish-English used significantly more correct productions on shared sounds compared to unshared sounds in English. Monolingual children in their study did not show significant differences between productions of these sounds. Similarly, Goldstein, Fabiano, & Iglesias (2003) found that typically developing sequential bilingual Spanish-English speaking children exhibited higher accuracy on shared sounds and syllable types than on unshared sounds and syllable types. High accuracy on shared sounds was found to be independent of the effect of developmental sequence. That is, the high accuracy of shared sounds was not simply caused by the tendency of these sounds to be acquired earlier than unshared sounds. In the production of MalE, a significant difference was similarly found between the accuracy of shared and unshared sounds in both SI and SF, with the accuracy of shared sounds was consistently higher than unshared sounds. All findings support the hypothesis that the speech sound acquisition of English bilingual children is substantially different to English monolinguals, thus also appear to apply to MalE speaking children who are learning Mandarin Chinese and Malay at the same time.

6.3.7 Vowel Accuracy by Syllable Type

In the present study, children’s vowel accuracy was lower in PSWs than MSWs and DSWs. Generally, older children’s vowel accuracy was higher than that found for younger children. This finding is in accordance with the results of vowel accuracy reported by James, van Doorn, & McLeod (2001) and (2002). They found that there were significant age, syllable number and interaction effects on 283 Australian children's vowel productions. They claimed that acquisition of syntagmatic aspects of vowel productions was taking place. James et al. (2001) discussed two possible reasons that could account for the discrepancies found in PVC in MSWs, DSWs and PSWs. First, the use of stress markers is different in words with different syllable types. For example, one level of stress is used in MSWs, whereas two levels of stress are needed in DSWs and three levels of stress are required in PSWs. More differential control is needed to produce PSWs which contain different levels of stress features than MSWs and DSWs. Second, durational aspects of speech sounds in PSWs relative to MSWs or DSWs, in those syllables in MSWs have greater duration than the same syllables in DSWs and PSWs. The increase in word length corresponds with a decrease in syllable duration. Word-final syllables which function as word boundary markers have greater duration than the same non-final syllables. For instance, the /tə/ syllable in the DSW 'butter' /bʌtə/ contains greater duration than the same syllable in the PSW 'tomato' /təmato/. Children are required to move their articulators more quickly to cope with the durational reduction. McKay (1978) and Young (1991) stated that atypical stress patterns (words containing initial unstressed syllables) are more difficult to perceive and produce than typical stress patterns (words containing non-initial unstressed syllables). Atypical stress such as in /təmato/ are thus more difficult to perceive and produce compared to typical stress as in /tomato/. It is therefore, understandable that children would have more difficulty producing PSWs compared to MSWs or DSWs.

PSWs were produced differently in MalE. The unstressed vowels in PSWs are usually substituted by full vowels in MalE, for examples, /təmato/ is produced as [tomato], with the syllables within the word sounding as if they have equal stress. Some SE speaking children use a full vowel for an unstressed vowel to facilitate production of an unstressed syllable, for instance, 'banana' [bʌnænə] for /bənænə/ (Young, 1991), implying that the use of a full vowel for an unstressed vowel is developmentally easier for children. Therefore, the interpretations made by James et al. (2001) about the acquisition of vowel in PSWs might not be exactly applicable in MalE even though the production of vowels in PSWs was considerably different from DSWs and MSWs. The factors explaining the relationship of the production of MalE PSWs and vowel accuracy will need further investigations.

6.3.8 Consonant Cluster Accuracy by Syllable Position

Consonant cluster accuracy by syllable position is seldom discussed by researchers. Powell (1993) reported that word-initial versus word-final position was not a factor in the difficulty of clusters for the 4 and 5 year old children. In the majority of studies, the comparison of clusters by position was done in terms of number of consonants produced in SI and SF instead of accuracy. Generally, young children produced more initial than final consonant clusters. For example, Stoel-Gammon (1987) found that 2 year old children produced a mean of 2.2 different initial clusters and 1.7 final clusters. Likewise, Dyson (1988) found that 3;03 year old children produced a mean of 10.7 different initial clusters and 7.7 different final clusters.

In the present study, final clusters were found to be produced more correctly than initial clusters in younger children. By contrast, older children showed higher accuracy of production in initial clusters than in final clusters. Higher accuracy of final clusters in younger children might be due to the influence of MalE. Reduction of certain final clusters is permitted in MalE, for instance, omission of final stop elements in final clusters. Younger children were thus observed to produce more correct final clusters than initial clusters. Among the older children, their initial cluster production development might be ahead of final clusters, and thus result in more correct production of initial clusters than final clusters.

6.3.9 Consonant Cluster Accuracy by Category

Most previous studies have not fully analyzed accuracy of consonant cluster categories. Smit et al.'s (1990) study only discussed the accuracy of specific clusters. Therefore, Smit et al.'s data for children aged 3 to 7 years old were recalculated based on cluster categories for comparison. The order of clusters based on the mean percentages of accuracy was: C + /w/ clusters (90.6%), C + /l/ clusters (74.7%), /s/ + C clusters (69.1%) and C + /r/ clusters (65.9%). The findings were different to the present study which found that /s/ + C clusters had the higher accuracy, followed by C + /w/ clusters, then C + /l/ clusters and C + /r/ clusters (65.9%). However, both studies agree that accuracy of /s/ + C clusters was higher than C + /r/ clusters. This is supported by McLeod and Arciuli (2009) who only compared /s/ + C clusters and C + /r/ clusters and found that the percentage of /s/ + C clusters was higher than C + /r/ clusters in 74 children aged 5 to 12 years old. Although previous studies and the present study agree that /s/ + C clusters are produced more accurately than C + /r/ clusters, overall /s/ + C clusters maybe produced more accurately in MalE than SE.

6.3.10 Consonant Cluster Accuracy by Number of Constituents

All researchers agree that three-element clusters are more difficult to produce accurately compared to two-element clusters (McLeod & Arciuli, 2009; Smit, et al., 1990; Templin, 1957), which is in accordance with the findings of the present study. In the present study, two-element clusters consistently had higher accuracy than three-element clusters across the age groups. Templin found that the mean percentages of accuracy for two-element and three-element clusters were 71.5% and 63.2% respectively. Smit et al. showed that the mean accuracy of syllable-initial two-element and three-element clusters for children between 3 and 7 years old was 71.3% and 56.6% respectively. McLeod and Arciuli found that the percentage of two-element /s/ + C clusters was higher than three-element /s/ clusters in 74 children aged 5 to 12 years old. The difficulty associated with accurately producing three-element clusters is largely due to the increased phonotactic complexity of merging three segments in comparison to two-element clusters. Acquisition of MalE consonant clusters followed this universal pattern as SE in terms of accuracy according to number of constituents.

6.4 SUMMARY

The findings of the present study indicate that speech sound accuracy differed when dialect features were taken into account. This supports the view that MalE dialectal features must be considered in any phonological analysis. There would be a number of unwanted consequences resulting from the failure to include MalE dialectal features during the assessment process. In particular, all typically developing MalE speaking children would have been characterized with at least mild-moderate speech disorders based on their PCC scores according to Shriberg & Kwiatkowski (1982) if MalE dialectal features were not considered. The results of this investigation therefore have significant implications for the assessment of phonological development of MalE speaking children. SLPs need to consider MalE dialectal features when assessing MalE speaking children in order to avoid misdiagnosis.

SLPs need to be aware of individual differences when assessing MalE speaking children as high individual variability is evident in the present study. SLPs should expect older children to exhibit greater speech sound accuracy than younger children. Furthermore, there is unlikely to be a sex differences in regard to speech sound accuracy.

When the consonants, vowels and consonant clusters were further examined based on specific features (e.g. sound class and syllable position), some differences were found in comparison to SE. MalE speaking children had more accurate productions of liquids but less accurate production of affricates than monolingual SE speaking children. MalE speaking children also showed better speech accuracy for consonants in SI than in SF. Shared sounds between English, Mandarin and Malay were produced more correctly than unshared sounds. This supported the concept of phonetic similarity (Flege, 1981, 1987). The vowel accuracy differed according to the number of syllables in words (as in MSWs, DSWs and PSWs), with lower consonant accuracy in PSWs. This confirms the need to include a significant number of PSWs in the phonological assessment of MalE speaking children. James (1997) recommended that the use of test words that consist of PSWs should become a standard clinical procedure to ensure valid and reliable testing of children's phonological skills. MalE speaking children did not show differences in terms of accuracy of consonant cluster production in SI and SF, but they produced more accurate productions of /s/ + C clusters and C + /w/ clusters than C + /l/ clusters and C + /r/ clusters. Generally, three-element clusters were more difficult to produce accurately compared to two-element clusters.

CHAPTER 7
PHONOLOGICAL PROCESSES

7.0 INTRODUCTION

The focus of this chapter was to investigate the phonological processes that were exhibited by MalE speaking children. The specific focuses of this chapter were:

1. To examine the types and occurrence of dialectal and developmental phonological processes exhibited by MalE speaking children.
2. To examine any significant differences in sex and age effects on the occurrence of phonological processes.
3. To determine the age of suppression for developmental phonological processes.
4. To compare the age of suppression for developmental phonological processes in MalE with Standard English (SE).

7.1 METHODS

Two types of phonological processes exhibited by MalE speaking children were examined: dialectal and developmental phonological processes. First, MalE dialectal features described in Chapter 3 were coded as dialectal phonological processes, for instance, glottal replacement, initial voiceless stop deaspiration, final stop devoicing and TH-stopping. Examples of the dialectal phonological processes are displayed in Appendix Q and audio samples are available on the CD included with this thesis. The second type of phonological processes was those which are commonly described for SE children, for example, stopping and unstressed syllable deletion. These processes were examined and grouped into developmental phonological processes.

Some precautionary steps were taken when deriving developmental phonological process data for MalE. Some phonological processes which are developmental in SE but are regarded as dialectal in MalE were not included in calculations for developmental phonological processes. These included devoicing of stops and final consonant devoicing (postvocalic devoicing), deaspiration of initial voiceless stops (prevocalic voicing), vocalization and simplification of diphthongs, vowel merging and use of full vowels for unstressed vowels (vowel changes). In the derivation of developmental phonological processes in MalE, some potential tokens were excluded because they exhibited MalE features. The adjustments to the calculation of developmental phonological processes were:

- Final /l/ was not included in the calculation of final consonant deletion because omission of final /l/ was a dialectal feature of MalE.
- TH-fronting in SI only (instead of in both SI and SF) was calculated for developmental phonological processes because TH-fronting in SF was acceptable in MalE.
- Both /θ/ and /ð/ in SI were excluded from the calculation of stopping, as TH-stopping in SI was a MalE dialectal feature.
- All final stop consonant clusters were excluded from final consonant cluster reduction analysis as this type of consonant cluster reduction was acceptable in MalE.

In addition to these exceptions, sounds that were allophonic to each other in MalE were considered when deriving the analysis of developmental phonological processes, such as stops and glottal stops in SF. Therefore, stopping of fricatives was deemed to have occurred if a glottal stop substituted for a fricative in SF.

The speech data of all children were analyzed by calculating the mean percentage and standard deviation for all individual processes. The total number of occurrences of the phonological processes was first calculated for individual children. Then, a percentage of occurrence for each phonological process was calculated for each child by dividing the total number of occurrences for each process by the total number of opportunities for the occurrence of that process. The data were analyzed for the presence of 15 developmental phonological processes. The taxonomy of phonological processes compiled for this study (see Appendix Q) included phonological processes described by Ingram (1981) and Stoel-Gammon (1985).

To be considered as an age appropriate phonological process in the children's phonological repertoire, more than 10% of the children in an age group (Dodd et al, 2003) had to exhibit the pattern at least 20% of the time and there had to be at least four opportunities for the process to occur (McReynolds and Elbert, 1981a). The age at which less than 10% of the children used a particular process 20% of the time (or more) was taken as the age at which the process was suppressed for the group.

7.2 RESULTS

7.2.1 Types and Occurrence of Phonological Processes

Table 7.1 describes the occurrence of dialectal phonological processes between 3 and 7 years of age. Many of the dialectal phonological processes had a high percentage of occurrence. For example, mean percentage of occurrence for final stop cluster reduction was in the range of 69% and 78%. Dialectal phonological processes progressed in four ways across age groups i) increased, ii) decreased, iii) fluctuated or iv) was stable.

- Dialectal phonological process usages which increased across age groups included glottal replacement, TH-stopping, TH-fronting, medial consonant /ʒ/ devoicing, vowel merging and use of full vowels for unstressed vowels.
- Dialectal phonological process usages which decreased across age groups consisted of devoicing of stops, substitution of /v/ with [w] and omission of past tense markers.
- Dialectal phonological process usages which fluctuated across age groups included vocalization and omission of final /l/.
- Dialectal phonological process usages which were stable across age groups consisted of deaspiration of voiceless stops, final consonant devoicing, final stop cluster reduction and simplification of diphthongs.

There were interrelationships between increased and decreased process usage. For example, an increase in glottal replacement use caused a decrease use of devoicing of stops. Vocalization and omission of final /l/ which fluctuated across age groups were also interrelated. When children in a particular age group used more vocalization of final /l/, reduction in omission of final /l/ occurred. Variability was observed in the use of dialectal phonological processes which was reflected in the very high standard deviation for most of MalE dialectal phonological processes. It is worth emphasizing that not all children or adults use all the MalE features, or use them all the time. Therefore, variability among the children in this study was to be expected.

From Table 7.2, a gradual decrease in the majority of developmental phonological processes can be observed such as in final consonant deletion, gliding and fronting. However, the occurrences of two phonological processes, final cluster reduction and deaffrication remained stable and did not decline as much as other processes. Variability was found for some developmental phonological processes, with standard deviations being greater than means, for example, cluster reduction, deaffrication, palatal fronting and TH-fronting. Variability has been reported in many studies of phonological processes such as Dodd, Holm, Hua, & Crosbie (2003), James (2001) and Roberts, Burchinal, & Footo (1990). James (2001) emphasized that caution should be taken when measures of central tendency are used for interpreting data.

Table 7.1: Mean Percentage (M) and Standard Deviation (SD) of Occurrence for Dialectal Phonological Processes for MalE Speaking Children between the Ages of 3 and 7 Years

Dialectal Phonological Processes	Number of Tokens	Syllable Position		3;00-3;05	3;06-3;11	4;00-4;05	4;06-4;11	5;00-5;05	5;06-5;11	6;00-6;05	6;06-6;11	7;00-7;05	7;06-7;11
Glottal Replacement	[36]	SF	M	51.11	51.07	58.33	55.37	59.91	65.65	68.01	51.28	70.19	77.69
			SD	27.03	32.05	26.51	28.95	30.52	31.81	22.70	29.17	24.78	20.52
Devoicing of Stops	[13]	SF	M	30.26	26.04	23.34	23.59	28.72	23.33	8.93	14.79	15.13	11.79
			SD	26.08	26.12	26.04	24.74	31.36	29.45	14.34	20.46	18.57	17.46
Deaspiration of Voiceless Stops	[24]	SI	M	40.56	35.26	33.19	39.72	49.44	48.33	48.52	45.83	49.44	45.83
			SD	20.80	17.09	14.92	17.26	19.04	17.25	19.20	14.73	19.04	17.95
Final Consonant Devoicing	[9]	SF	M	47.41	50.43	52.11	44.44	45.93	56.30	47.67	50.43	52.96	43.33
			SD	22.80	19.93	18.57	21.04	16.95	17.49	19.71	19.57	14.79	19.65
TH-Stopping	[9]	SI	M	62.96	72.22	79.69	79.26	81.85	81.11	86.38	93.16	90.37	83.33
			SD	26.45	18.39	12.62	13.29	10.71	16.02	13.06	7.23	10.00	14.22
TH-Fronting	[3]	SF	M	53.33	60.26	60.92	71.11	73.33	80.00	79.57	89.74	77.78	76.67
			SD	35.19	36.54	32.21	31.24	29.56	25.67	23.85	16.01	23.71	30.51
Vocalization	[12]	SF	M	19.44	15.38	22.41	21.67	22.22	14.17	24.19	23.72	25.00	18.89
			SD	15.64	11.71	15.45	15.26	18.22	14.70	19.53	11.71	17.64	13.12
Omission of Final /l/	[12]	SF	M	72.22	76.92	69.83	66.39	66.39	74.72	59.68	63.46	56.67	61.11
			SD	18.54	15.87	17.87	15.08	17.30	19.88	24.64	16.51	23.41	19.98
Substitution of /v/ with [w]	[6]	SI	M	66.67	44.87	33.91	28.33	22.22	12.78	32.80	16.67	13.33	11.11
			SD	87.97	64.42	37.40	35.87	28.14	23.03	36.64	28.05	22.06	14.73
Medial Consonant /ʒ/ Devoicing	[2]	SI	M	36.67	40.38	37.93	58.33	51.67	60.00	58.06	65.38	58.33	55.00
			SD	35.19	24.57	28.83	23.06	24.51	27.54	22.72	24.02	18.95	24.03
Final Stop Cluster Reduction	[11]	SF	M	70.30	69.93	69.91	78.48	77.27	76.36	74.19	70.63	69.70	66.97
			SD	18.65	16.22	14.60	14.02	14.47	15.58	18.20	19.69	14.97	18.10
Omission of Past Tense Markers	[4]	SF	M	50.00	37.50	29.31	32.50	20.00	28.33	14.52	19.23	18.33	22.50
			SD	25.00	35.53	29.93	30.90	24.03	29.16	23.07	25.32	22.68	31.04
Simplification of Diphthongs	[33]	na	M	78.79	82.75	80.77	78.69	74.85	79.90	79.28	83.68	82.02	83.43
			SD	8.02	6.40	6.84	10.66	10.50	7.61	7.39	9.30	6.89	6.83
Vowel Merging	[143]	na	M	5.08	5.57	7.11	8.28	8.76	10.58	7.78	5.97	7.18	7.81
			SD	0.86	1.92	1.47	2.05	2.80	3.37	2.02	1.86	1.94	1.57
Use of Full Vowel for Unstressed Vowel	[64]	na	M	10.52	14.78	15.84	17.19	17.14	17.97	18.30	18.51	19.58	17.08
			SD	3.71	2.18	2.70	2.72	3.08	2.62	2.91	2.91	2.49	3.87

Table 7.2: Mean Percentage (M) and Standard Deviation (SD) of Occurrence for Developmental Phonological Processes for MalE Speaking Children between the Ages of 3 and 7 Years

Developmental Phonological Processes	Number of Tokens	Syllable Position		3;00-3;05	3;06-3;11	4;00-4;05	4;06-4;11	5;00-5;05	5;06-5;11	6;00-6;05	6;06-6;11	7;00-7;05	7;06-7;11
Final Consonant Deletion	[112]	SF	M	4.94	4.91	3.60	2.92	2.59	2.02	1.58	1.37	1.67	2.56
			SD	3.98	4.98	2.95	2.34	1.45	1.66	1.47	0.86	1.36	1.69
Consonant Cluster Reduction	[6]	SF	M	25.56	22.44	10.92	13.89	27.22	16.11	20.43	14.10	12.22	16.11
			SD	23.46	22.08	13.57	13.19	17.22	13.48	17.06	11.48	13.79	20.29
	[47]	SI	M	27.94	22.34	13.57	12.98	11.21	8.44	7.89	9.66	7.09	8.01
			SD	16.67	13.65	8.07	7.69	6.17	3.89	4.89	4.31	3.64	3.38
Consonant Cluster Simplification	[31]	SI	M	9.25	10.05	10.23	4.84	5.91	3.87	1.56	3.72	2.04	1.72
			SD	8.44	9.50	14.81	7.32	9.28	4.35	2.87	8.82	4.44	3.25
Epenthesis	[47]	SI	M	3.40	2.37	1.54	0.78	1.70	2.48	0.62	0.49	0.35	0.50
			SD	6.42	3.53	1.88	1.42	2.58	2.44	1.25	1.27	0.98	1.21
	[14]	SF	M	0.48	0.27	0.74	0.71	0.00	0.24	0.92	0.00	0.24	0.48
			SD	1.84	1.40	2.21	2.18	0.00	1.30	3.05	0.00	1.30	1.81
Deaffrication	[5]	SF	M	45.33	26.15	26.21	24.00	19.33	31.33	25.16	18.46	20.00	18.67
			SD	33.35	30.86	37.84	33.79	30.39	35.50	36.14	25.12	31.07	28.74
Liquids Gliding	[33]	SI	M	8.08	5.71	5.75	1.01	1.52	2.12	0.98	4.90	0.30	2.42
			SD	9.14	12.31	16.76	1.84	3.88	4.07	2.40	15.92	0.92	13.28
Palatal Fronting	[11]	SI, SF	M	20.00	12.24	5.96	2.42	2.12	2.42	1.76	0.70	1.21	1.21
			SD	24.83	21.50	7.79	4.73	3.91	4.09	3.65	2.52	3.14	3.95
Stopping of Affricates	[15]	SI, SF	M	5.00	3.08	1.38	2.50	1.50	1.67	1.29	0.00	0.33	0.33
			SD	6.81	6.34	3.24	4.69	2.67	4.01	2.88	0.00	1.27	1.83
Stopping of Fricatives	[86]	SI, SF	M	4.73	2.68	1.48	0.78	0.70	0.31	0.68	0.36	0.50	0.39
			SD	6.28	5.20	1.91	2.01	1.08	0.80	1.03	0.73	0.90	0.77
TH-Fronting	[9]	SI	M	5.19	1.28	14.18	14.44	12.22	11.85	10.04	5.13	7.41	10.74
			SD	8.26	3.62	9.34	8.83	8.43	11.65	11.95	7.34	6.74	9.45
Velar Fronting	[55]	SI, SF	M	2.18	3.57	1.32	0.61	1.03	1.39	1.35	1.40	0.73	0.30
			SD	1.97	6.69	1.88	1.10	1.49	2.17	0.81	0.80	1.55	0.69
Unstressed Syllable Deletion	[58]	na	M	2.87	1.66	1.25	0.86	0.92	0.75	0.61	0.93	0.29	0.34
			SD	4.00	2.56	1.78	1.41	1.34	1.33	0.95	1.34	0.80	0.83
Affrication	[50]	SI, SF	M	4.67	4.23	3.17	2.33	2.73	2.07	3.55	2.31	1.27	1.73
			SD	5.22	5.78	3.98	2.73	3.46	2.60	3.71	4.75	1.93	2.21
Omission of plural markers	[4]	SF	M	21.67	19.23	12.07	5.83	4.17	4.17	0.81	1.92	0.83	3.33
			SD	20.85	24.81	15.84	10.75	9.48	13.27	4.49	6.93	4.56	10.85

7.2.2 Correlations between Phonological Processes and Age Groups

The developmental trend of a marked decline in process usage was examined by correlating process usage with age using *Pearson* statistics (see Table 7.3). All developmental phonological processes were significantly correlated with age except final cluster reduction, final epenthesis and TH-fronting. The negative correlations between process usage and age group provided evidence for a decline in process usage and also suggested a systematic age-related decline. Independent group *t*-tests were run to examine sex differences in the occurrence of all developmental phonological processes. Table 7.4 lists the results of these tests. There were no significant sex differences for any phonological processes in any age group except unstressed syllable deletion. Male children used significantly more unstressed syllable deletion (M = 0.74, SD = 1.25) than female children (M = 0.37, SD = 0.73), t (262) = -2.82, p < 0.01.

Table 7.3: Correlations between Developmental Phonological Processes and Age Groups

Developmental Phonological Processes	*N*=264	
	r	*p*
Final Consonant Deletion	-.336*	.000
Consonant Cluster Reduction	-.099	.110
	-.509*	.000
Consonant Cluster Simplification	-.343*	.000
Epenthesis	-.260*	.000
	-.020	.752
Deaffrication	-.122*	.048
Liquid Gliding	-.157*	.011
Palatal Fronting	-.352*	.000
Stopping of Affricates	-.266*	.000
Stopping of Fricatives	-.312*	.000
TH-Fronting	.041	.511
Velar Fronting	-.220*	.000
Unstressed Syllable Deletion	-.297*	.000
Affrication	-.206*	.001
Omission of Plural Markers	-.377*	.000

* Correlation is significant at the 0.01 level (2-tailed).

Table 7.4: Results of *t*-test Comparisons between Females and Males for Developmental Phonological Processes

Developmental Phonological Processes	Sex	*N*	*M*	*SD*	*t* (262)	*p*
Final Consonant Deletion	F	139	3.05	2.96	-.17	.853
	M	125	3.11	3.12		
Cluster Reduction	F	139	0.99	1.01	-1.24	.943
	M	125	1.14	1.07		
	F	139	5.74	4.63	.20	.389
	M	125	5.63	4.37		
Cluster Simplification	F	139	1.45	2.28	-.83	.225
	M	125	1.72	2.96		
Epenthesis	F	139	0.63	1.02	-.15	.661
	M	125	0.65	1.42		
	F	139	0.06	0.27	.28	.561
	M	125	0.06	0.23		
Deaffrication	F	139	1.21	1.62	-.31	.622
	M	125	1.27	1.68		
Liquid Gliding	F	139	0.72	2.30	-1.21	.063
	M	125	1.18	3.84		
Palatal Fronting	F	139	0.40	1.11	-1.11	.146
	M	125	0.56	1.29		
Stopping of Affricates	F	139	0.34	0.79	.35	.459
	M	125	0.30	0.77		
Stopping of Fricatives	F	139	0.89	2.23	-.377	.493
	M	125	1.00	2.42		
TH-Fronting	F	139	0.81	0.84	-1.44	.311
	M	125	0.97	0.92		
Velar Fronting	F	139	0.69	1.63	-.34	.663
	M	125	0.75	1.22		
Unstressed Syllable Deletion	F	139	0.37	0.73	-2.90	.001*
	M	125	0.74	1.25		
Affrication	F	139	1.56	1.85	1.91	.170
	M	125	1.13	1.84		
Omission of Plural Markers	F	139	0.23	0.49	-1.14	.013
	M	125	.31	0.68		

* Significant level at 0.01.

7.2.3 Age of Suppression for Developmental Phonological Processes

The age of suppression for developmental phonological processes was derived based on the criterion of less than 10% of the children using a particular process 20% of the time. Table 7.5 lists the proportion of children who used developmental phonological processes for each age group.

Table 7.5: Percentage of Children using Developmental Phonological Processes on More than 20% of the Opportunities for Occurrence

Phonological Processes \ Age	3;00	3;06	4;00	4;06	5;00	5;06	6;00	6;06	7;00	7;06
Deaffrication	80.00	53.85	44.83	43.33	36.67	50.00	41.94	46.15	36.67	40.00
Omission of Plural Markers	60.00	50.00	41.38	23.33	16.67	10.00	3.23	7.69	3.33	10.00
Final Cluster Reduction	46.67	30.77	13.79	16.67	50.00	23.33	35.48	15.38	16.67	26.67
TH Fronting	13.33	0.00	31.03	30.00	26.67	26.67	22.58	7.69	6.67	33.33
Initial Cluster Reduction	46.67	38.46	13.79	13.33	10.00	0.00	3.23	0.00	0.00	0.00
Cluster Simplification	6.67	11.54	13.79	6.67	10.00	0.00	0.00	7.69	0.00	0.00
Palatal Fronting	33.33	15.38	6.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquid Gliding	6.67	11.54	3.45	0.00	0.00	3.33	0.00	7.69	0.00	3.33
Stopping of Fricatives	13.33	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stopping of Affricates	6.67	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Velar Fronting	0.00	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unstressed Syllable Deletion	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Epenthesis – SI	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Epenthesis – SF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Affrication	0.00	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consonant Deletion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

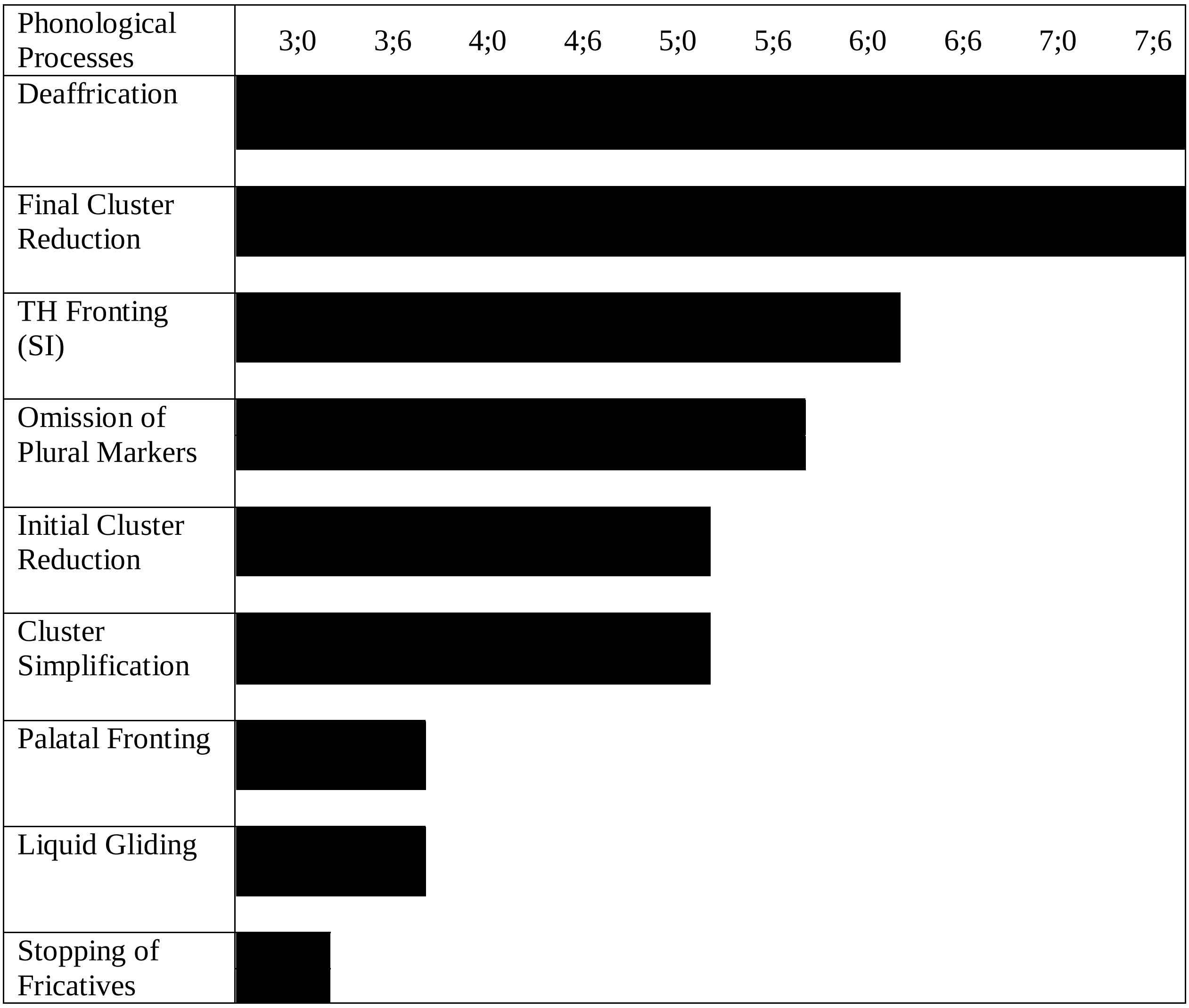
Developmental phonological processes were then divided into two major categories: processes that were suppressed by the age of 3 years and those that persisted beyond 3 years as proposed by Stoel-Gammon (1985). Table 7.6 lists the phonological processes that were suppressed by or persisted after 3 years old.

Table 7.6: Processes that were Suppressed by or Persisted after 3 Years of Age

Processes Suppressed by 3 years old	Processes Persisting after 3 years old
• Stopping of Affricates	• Deaffrication
• Velar Fronting	• Omission of Plural Markers
• Unstressed Syllable Deletion	• Final Cluster Reduction
• Epenthesis	• TH-Fronting
• Affrication	• Initial Cluster Reduction
• Final Consonant Deletion	• Cluster Simplification
	• Palatal Fronting
	• Liquid Gliding
	• Stopping of Fricatives

Processes that persist beyond 3 years were further considered based on discrete age levels when these processes were fully suppressed. As can be seen from Figure 7.1, stopping of fricatives was suppressed by 3;06 years of age, followed by liquid gliding and palatal fronting which were suppressed at age of 4;00. Initial cluster reduction and simplification no longer persisted after 5;06 years old. Omission of plural markers was suppressed before 6 years. TH-fronting was suppressed before 6;06 years. Deaffrication and final cluster reduction were not suppressed even for the oldest age group in the present study. This finding was consistent with correlation results mentioned above where no correlation was found between the usage of these two processes and age group.

Figure 7.1: Developmental Phonological Process Used by 10% of the Children Who Exhibited the Process at least 20% of the time



- The solid bar corresponding to each developmental phonological process begins at the age at which more than 10% of the children in an age group exhibited the pattern at least 20% of the time (an appropriate age of phonological process use) and ends at the age at which less than 10% of the children used a particular process at least 20% of the time (age of suppression of phonological process use).

7.2.4 Non-Process Errors

Phonological process analysis accounts for systematic changes to a whole class of sounds (e.g. stopping of fricatives refers to substitution of stops for all fricatives). According to Smit (1993), non-process errors are very common phoneme-specific errors that do not affect a whole class of sounds and thus do not fit neatly into a phonological process description. However, some of these sound changes were very common in MalE speaking children's productions and thus are worth noting. For example, the only fricative that was regularly stopped was /v/, this was counted as a non-process error.

Some detailed analyses of these specific sound errors were done in order to provide more in depth information. The mean and standard deviation of these non-process errors are displayed in Table 7.7. Table 7.8 shows the percentage of children using non-process errors on at least 20% of the opportunities for occurrence. The age of suppression of these non-process errors is illustrated in Figure 7.2.

Stopping of Fricatives

Stopping of fricatives was suppressed at 3;06 years of age. However, stopping occurred with higher frequencies in /v/. Stopping of /v/ was suppressed half a year later than overall fricative stopping.

Affrication of /z/

Affrication was suppressed before 3 years of age, which was considered relatively early. However, /z/ was affricated more often than other fricatives. Affrication of /z/ persisted until 6;06 years old.

Final Consonant Deletion

Final consonant deletion was suppressed before 3 years of age. Nonetheless, deletion of final fricatives was more prevalent than deletion of other sound classes such as stops and affricates. Final fricative deletion was suppressed at the age of 4 ½ years.

Cluster Reduction

Initial cluster reduction occurred for both two-element and three-element clusters. In the phonological analysis, both types of clusters were analyzed as wholes. When these types of consonant cluster were analyzed separately, the results revealed obvious differences. Dodd et al. (2003) found that three-element clusters were suppressed one year later (4;11 years old) than two-element clusters (3;11 years old). As shown in Table 7.8, the mean percentage children who exhibited two-element cluster reduction was much lower than for three-element cluster reduction. The age of suppression for two-element and three-element cluster reduction differed greatly. Two-element cluster reduction was suppressed before 4;06 years old, while three-element cluster reduction was not suppressed even for the oldest age group in the present study.

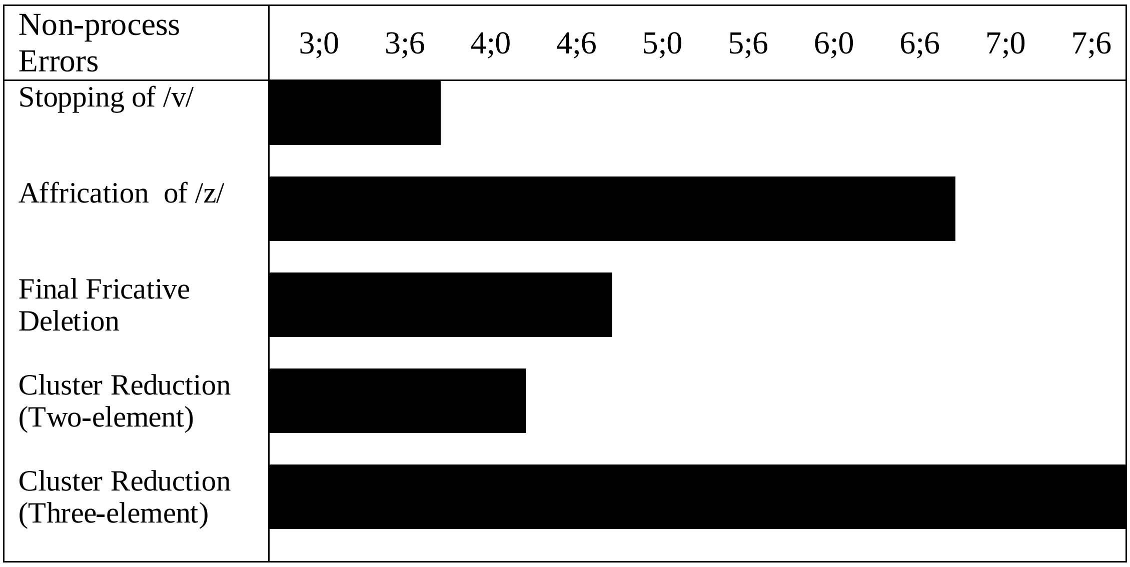
Table 7.7: Mean Percentage (M) and Standard Deviation (SD) of Occurrence for Non-process Errors for MalE Speaking Children between the Ages of 3 and 7 Years

Non-process Errors	Number of Token	Age	3;00	3;06	4;00	4;06	5;00	5;06	6;00	6;06	7;00	7;06
Stopping of /v/	[12]	M	9.44	5.13	3.74	1.67	1.94	1.11	1.88	1.28	1.39	1.67
		SD	8.25	8.19	5.26	4.04	5.22	2.88	5.14	3.13	3.16	4.59
Affrication of /z/	[12]	M	8.25	10.67	11.24	8.95	14.08	10.81	15.35	15.96	7.81	8.23
		SD	2.00	2.00	2.00	1.00	2.00	2.00	2.00	0.00	0.00	0.00
Final Fricative Deletion	[23]	M	13.33	12.37	8.25	10.29	7.83	4.93	6.59	6.35	7.54	8.99
		SD	11.79	14.79	5.73	9.45	5.28	4.53	6.24	4.21	6.03	7.12
Cluster Reduction (Two-element)	[42]	M	26.67	19.78	11.49	9.92	8.57	5.79	5.91	8.06	5.24	5.08
		SD	17.64	13.70	7.40	7.63	5.68	3.84	4.47	4.19	3.61	3.63
Cluster Reduction (Three-element)	[5]	M	38.67	43.85	31.03	38.67	33.33	30.67	24.52	23.08	22.67	32.67
		SD	17.67	22.64	19.70	18.89	16.05	13.63	16.09	13.77	12.58	18.56

Table 7.8: Percentage of Children using Non-process Errors on More than 20% of the Opportunities for Occurrence

Non-process Errors	Age / Number of Token	3;00	3;06	4;00	4;06	5;00	5;06	6;00	6;06	7;00	7;06
Stopping of /v/	[12]	40.00	15.38	6.90	3.33	3.33	0.00	3.23	0.00	0.00	6.67
Affrication of /z/	[12]	6.67	19.23	20.69	10.00	16.67	16.67	22.58	15.38	6.67	3.33
Final Fricative Deletion	[23]	13.33	19.23	6.90	10.00	0.00	3.33	0.00	0.00	3.33	6.67
Cluster Reduction (Two-element)	[42]	46.67	38.46	10.34	6.67	6.67	0.00	3.23	0.00	0.00	0.00
Cluster Reduction (Three-element)	[5]	100.00	96.15	89.66	96.67	96.67	100.00	83.87	84.62	86.67	80.00

Figure 7.2: Non-process Errors Used by 10% of the Children Who Exhibited the Process at least 20% of the time



- The solid bar corresponding to each developmental phonological process begins at the age at which more than 10% of the children in an age group exhibited the pattern at least 20% of the time (an appropriate age of phonological process use) and ends at the age at which less than 10% of the children used a particular process at least 20% of the time (age of suppression of phonological process use).

Three-element cluster reduction was further analyzed by looking at the types of reduction: singleton (I) (e.g. /spl/→/p/) or two-element (II) reduction (e.g. /spl/→/sp/). Table 7.9 shows the percentage of occurrence and of children who reduced three-element clusters into singletons or two- element clusters. The percentage of occurrence and of children who reduced three-element clusters to singleton consonants decreased as age increased. By contrast, the percentage of occurrence and children who reduced three-element clusters to two- element clusters increased as age increased, until by age 7;06, all children were reducing three-element clusters to two-element clusters all the time.

Table 7.9: Percentage of Occurrence of Three-element Cluster Reduction Processes and Percentage of MalE speaking Children Demonstrating the Processes

Percentage	Element	Age Group									
		3;00	3;06	4;00	4;06	5;00	5;06	6;00	6;06	7;00	7;06
Occurrence	I	33.33	29.31	4.44	10.34	4.00	4.35	7.89	6.67	2.94	0.00
	II	66.67	70.69	95.56	89.66	96.00	95.65	92.11	93.33	97.06	100.00
Children	I	40.91	30.30	7.41	15.15	6.67	6.45	10.34	7.69	3.85	0.00
	II	59.09	69.70	92.59	84.85	93.33	93.55	89.66	92.31	96.15	100.00

I – Singleton Reduction (e.g. /spl/→/p/)
II – Two-element Reduction (e.g. /spl/→/sp/)

7.2.5 Comparison of Developmental Phonological Processes in MalE and SE

The age of developmental phonological process suppression in MalE was compared to SE (Dodd et al., 2003; Haelsig & Madison, 1986; Roberts et al., 1990) as shown in Table 7.10. Haelsig & Madison and Roberts, et al. and the present study used the criterion where “less than 10% of the children used a particular process 20% of the time or more” as the age which the process had suppressed for the group. Dodd et al. used the criterion where “less than 10% of the children used a particular process in at least 5 instances” as the age which the process had suppressed for the group.

Haelsig & Madison (1986) reported relatively later ages of phonological process suppression compared to the other studies. There are two possible reasons for this. First, the number of children studied was small (10 subjects for each 6 months age interval) and great variation might therefore be found in the results. Second, a greater number of words with greater phonotactic complexity were used as stimuli in their study which might result in later ages of phonological process reduction (James, 2001).

When developmental phonological processes in MalE were compared to SE, similarities were found for fronting, stopping, affrication and final consonant deletion across studies. These processes were usually suppressed around 3 years of age. Discrepancies were found for unstressed syllable deletion, cluster reduction, liquid gliding and deaffrication. Inconsistencies of age of suppression were reported for unstressed syllable deletion and cluster reduction. The age of suppression of unstressed syllable deletion varied between 2;06 and beyond 5 years across studies. The age of suppression for cluster reduction ranged from 4;00 to 7;00 years old across studies. SE studies showed a later age of suppression of liquid gliding (within the age range of 4;06

- 6;00 years) while liquid gliding was suppressed at age 4 years in MalE. Deaffrication was suppressed between 3;06 – 5;00 years in SE studies but persisted after 7 years in MalE.

The types of fronting were not described in detail in the SE studies, so it was unclear which types of fronting (velar, palatal or TH-fronting) were referred to. Variation might be found among different types of fronting. In the present study, velar fronting was suppressed before 3 years, palatal fronting persisted until 3 ½ years and TH-fronting was suppressed only at 6 ½ years.

Table 7.10: Age at which Phonological Processes were Suppressed in the Present Study Compared to Previous Studies

Authors	Haelsig & Madison (1986)	Roberts, Burchinal & Footo (1990)	Dodd et al. (2003)	Present Study
Age Range / Phonological Processes	2;10-5;02	2;06-8;11	3;00-6;11	3;00-7;11
Liquid gliding	4;06	5;00	6;00	4;00
Fronting	4;06	3;06	4;00	<3;00-6;06*
Stopping	5;00	3;00	3;06	3;06
Unstressed syllable deletion	> 5;00	< 2;06	4;00	<3;00
Final consonant deletion	4;06	< 2;06	X	<3;00
Deaffrication	X	3;06	5;00	>7;11
Cluster reduction	5;00	7;00	4;00-5;00	>5;06
Affrication	<3;00	X	X	X

X - not tested or reported
* - Fronting was suppressed with different age levels depending on the types (velar, palatal or TH- fronting)

7.3 DISCUSSION

Many phonological processes that are normal for adults who speak MalE, were similar to developmental phonological patterns in SE children. Examples of these processes include devoicing of final stops, de-aspiration of initial voiceless stops, vocalization of /l/, and stopping of fricatives /θ/ and /ð/, These phonological processes have previously been found to be suppressed for children learning SE (Haelsig & Madison, 1986; James et al., 1999) but were normal for both adults and children who speak MalE. Therefore, dialectal and developmental phonological processes of MalE should be clearly distinguished to avoid misinterpretation of children's phonological processes. A total of

15 dialectal phonological processes and 12 developmental phonological processes were identified for MalE speaking children in the present study.

7.3.1 Dialectal Phonological Processes

Dialectal phonological processes had higher and consistent mean percentages of occurrence and standard deviations across age groups in comparison to developmental phonological processes. For example, there were mean percentages of occurrence as high as 90% in TH-stopping (SF). Not all of the dialectal phonological process use was stable over time or used most often by younger children. Many studies of dialectal English such as AAVE or Spanish-influenced English report that younger children exhibit greater dialect density (Goldstein & Iglesias, 2001; McGregor & Reilly, 1998; Poplack, 1980; Terrell, 1981; Washington & Craig, 1992). That is, younger children consistently use more dialect features than older children. The reasons for higher dialect density in younger children included differences in geographical areas or regions (urban or rural) (Terrell, 1981; Washington & Craig, 1992) or speaking situations (formal or informal) (Poplack, 1980). However, none of these factors are applicable to the present study as these factors were controlled. Four progression patterns were observed in dialectal phonological process. The process use increased, decreased, fluctuated or was stable across age groups. These findings indicate the importance of identifying dialectal phonological processes, which could be interpreted by chance as developmental due to the increase or decrease of process use. Possible explanations for the dialectal process use are:

- Increased process use might be due to older children being better in attempting MalE adults' realization than younger children. For instance, the lack of TH-fronting in younger children occurred because they omitted the syllable-final /θ/ sound, while older children retained the syllable-final /θ/ sound and exhibited TH-fronting.
- Decreased process use might be due to older children being more aware of the differences of certain speech sound productions in MalE and SE as the result of increased literacy and attempting to produce a SE model. For example, older children might be aware of the differences between /v/ and /w/, and thus produce less substitution of /v/ with [w]. Children were asked to imitate targeted responses when they failed to produce the past tense markers. Decreased use of

past tense marker omission was mainly due to older children being better in imitating the targeted responses.

- Increased process use might also be interrelated with decreased process usage. For example, an increase in glottal replacement use caused the decreased use of devoicing in stops.
- Fluctuation of process use might occur when two processes were interrelated. For example, when children in a particular age group used more vocalization of final /l/, reduction in omission of final /l/ occurred. The fluctuation of process use might also reflect the substantial variation in MalE features exhibited by different children.
- Process use that remained stable over time indicated that MalE children consistently exhibited these features. These processes such as deaspiration of voiceless stops, final consonant devoicing, final stop cluster reduction and simplification of diphthongs might be prominent in MalE.

Therefore, it is crucial to understand how these processes interact with each other and change over time and differentiate them from developmental phonological processes.

7.3.2 Developmental Phonological Processes

The majority of developmental phonological processes reduced consistently across age groups. However, the use of final cluster reduction, deaffrication and TH-fronting fluctuated across age groups. Fluctuation of process usage is common in many studies of phonological development. For example, James (2001) found fluctuating use of 9 out of 30 phonological processes in her study. Roberts, Burchinal, & Footo (1990) found a similar pattern for final consonant deletion and deaffrication. There was a great deal of individual variation in the present study which was indicated by the standard deviation being greater than the mean. Children varied in their process usage. Individual variability in phonological process use has been reported by Dodd, Holm, Hua, & Crosbie (2003), Haelsig & Madison (1986), James (2001) and Roberts, Burchinal, & Footo (1990). The variability found in the present study reflects normal developmental trends rather than methodological limitations, as large scale studies such as Dodd et al. (2003) and Roberts et al. (1990) have reported the similar findings.

7.3.3 Correlations between Developmental Phonological Process Use and Age Group

The correlation between developmental process usage and age group provides evidence for the rapid decline in process usage of children between the ages of 3 and 7 years. The pattern of negative correlation between age and processes indicated that the processes show systematic age-related decline. However, there were three developmental phonological processes which did not decline with age. They were final cluster reduction, final epenthesis and TH-fronting. Possible explanations for the lack of correlation of these three phonological processes with age are:

- A decrease of final cluster reduction was not correlated with age. This is probably because the age group included in the cross-sectional study was not old enough to detect a developmental pattern. Further investigation of the use of final clusters in older children would be necessary to assess whether there is a developmental decline in final cluster process usage.
- The use of final epenthesis was uncommon in MalE speaking children. Final epenthesis occurred with very low occurrence, therefore, the decline rate might be minimal and lead to an insignificant correlation with age. Haelsig & Madison (1986), James (2001) and Roberts, et al. (1990) also found rarely used processes such as reduplication and final consonant devoicing did not decline linearly.
- The use of TH-fronting was found to be common only when children imitated targeted responses. It was less likely to be demonstrated by children who produced the words spontaneously because the majority of such children spontaneously replaced syllable initial /θ/ with [t] as permitted in MalE variants. Children who failed to name the pictures spontaneously and imitated the targeted response /θ/ produced [f] for /θ/ as demonstrated by SE speaking children (James, 2001; Smit, 1993b). Therefore, the use of the TH-fronting process is related to the children's modes of response rather than age. It is believed that TH-fronting usage would have been minimal if children had produced the words with /θ/ spontaneously.

7.3.4 The Effect of Sex on Phonological Process Use

The failure of this study to find sex differences with respect to the majority of phonological process usage was consistent with the findings of previous studies such as Roberts et al. (1990) and Winitz (1959). The only sex difference found was in unstressed syllable deletion, where male children used significantly more unstressed syllable deletion than female children. This finding was similar to McCormack & Knighton's (1996) study which found that unstressed syllable deletion was one of three phonological processes besides final consonant deletion and cluster reduction that were used more by males than females. However, in the present study, a sex effect was not found for final consonant deletion and cluster reduction. According to McCormack & Knighton, unstressed syllable deletion, final consonant deletion and cluster reduction were phonological processes that were related to changes in syllable structure. They felt that the level where sex differences could arise was the cognitive-linguistic level. The differences in syllable structure simplification might be due to a different maturity level in the cognitive-linguistic acquisition of the speech sound system itself, for instance, reducing syllable structure as an indirect way of dealing with phonetic immaturity.

7.3.5 Age of Suppression of Phonological Processes and Non-process Errors

Processes that were suppressed by 3 years old

Stopping of affricates, velar fronting, unstressed syllable deletion, epenthesis, affrication and final consonant deletion disappeared by 3 years old. The age of suppression of these phonological processes was similar to SE, except for unstressed syllable deletion and the use of non-process errors which will now be considered.

- The age of suppression for the use of unstressed syllable deletion was wide-ranging in SE. It was suppressed by 2;06 years old as reported by Roberts et al. (1990) and was not suppressed even by 5 years of age in Haelsig & Madison's (1986) study. The sampling of polysyllabic words is one of the crucial factors affecting the use of unstressed syllable deletion (James, 2001). Studies which include more polysyllabic words usually find a later age of unstressed syllable deletion suppression. However, in the present study, unstressed syllable deletion was suppressed earlier relative to many SE studies such as Haelsig & Madison (1986) and Dodd et al. (2003), even though the present stimuli included PSWs. This discrepancy might be related to the distinctive way PSWs are produced in MalE. The unstressed vowels in MalE were commonly realized as full vowels.

In SE, *telephone* /tɛlə̠fon/ and *elephant* /ɛlə̠fənt/ contain unstressed syllables with a /ə/ while *lollipop* /lɑlɪ̠pɑp/ has an /ɪ/. The weak syllable /ɪ/ in *lollipop* was less likely to be deleted as opposed to /ə/ in *telephone* and *elephant* as reported by Young (1991). Many of the unstressed syllables with a /ə/ in PSWs have become full vowels in MalE. For examples, /tɛlə̠fon/ becomes [tɛlɪ̠fon], /ɛlə̠fənt/ becomes [ɛlɪ̠fənt], pyjamas /pə̠dʒaməs/ becomes [pɪ̠dʒaməs], helicopter /hɛlə̠kɑptər/ becomes [hɛlɪ̠kɑptə]. The presence of /ɪ/ in these words might reduce the occurrence of unstressed syllable deletion in MalE.

MalE speaking children exhibited some non-process errors which were uncommon in SE:

- Affrication was suppressed before 3 years old, but affrication of /z/ continued until 6;06 years old. The high usage of affrication of /z/ is probably due to cross-linguistic effects from Mandarin Chinese phonology. Zhao (1995) mentioned that /z/ is absent from Mandarin Chinese and frequently replaced by the unaspirated voiced affricate [dz]. Holm & Dodd (1999) found that two bilingual Cantonese-English children affricated some fricatives in English. All these findings indicate that English speaking Chinese children tend to affricate fricatives more than monolingual English children.
- Final consonant deletion was rare after 3 years old, but deletion of final fricatives was only suppressed at the age 4 ½ years old. Frequent deletion of fricatives was probably due to the lack of syllable-final consonants in Mandarin Chinese and Malay.

If MalE children older than 3 years of age produce any one or a combination of the above processes, these processes may indicate a delayed or disordered phonological system. SLPs need to pay particular attention to non-process errors. Non-process errors should always be taken into consideration when assessing MalE speaking children's usage of phonological processes.

Processes that persisted after 3 years old

Phonological processes persisting after 3 years of age included deaffrication, initial and final cluster reduction, cluster simplification, TH-fronting, omission of plural markers, palatal fronting, stopping of fricatives and liquid gliding. These will now be discussed.

- Deaffrication was normally suppressed before 5 years of age in SE but persisted until 7 years of age in MalE speaking children. The extensive use of deaffrication is associated with the production of syllable-final affricates. MalE speaking children found syllable-final affricates difficult as both Mandarin Chinese and Malay did not share any syllable-final affricates with English. Therefore, deaffrication was used frequently across the age range of 3 to 7 years.
- Both initial cluster reduction and cluster simplification were suppressed before 5;06 years of age. Nevertheless, cluster reduction should be interpreted cautiously and the types of clusters should be considered. Different findings with respect to cluster reduction might result from different inclusion criteria being used across the studies. For example, studies which include only two-element clusters will find earlier age of cluster reduction suppression than those which include both two- and three-element clusters.
- Final cluster reduction was not suppressed at the upper age limit of the present study. Therefore, further observation of the suppression of these phonological processes could only be done with inclusion of children older than 7 years.
- The use of TH-fronting is subjected to children's modes of response towards stimuli, either spontaneous or imitation. This factor should be considered during phonological assessment.
- The omission of plural markers which was suppressed in older children due to children's increased awareness of the presence of word-final morphemes. Omission of plural markers in bimorphemic clusters such as chicks /tʃɪks/ was found to be suppressed (at age of 5;06 years). This was earlier than final cluster reduction such as box /bɒks/ (monomorphemic clusters) in the present study. This is probably because children were asked to imitate plural markers when they failed to produce them spontaneously. This helped to draw children's attention on the production of word-final morphemes.

- Stopping of fricatives was suppressed before 3;06 years old. Nonetheless, stopping of /v/ persisted slightly longer until 4;00 years old. Therefore, allowances should be made for the occurrence of /v/ stopping.
- An earlier age of phonological process suppression was found for liquid gliding. Liquid gliding was suppressed at age 4 years in MalE, which was 6 months to 2 years earlier than in SE. The early suppression of liquid gliding might be closely related to the correct production of singleton /l/ and /r/. Both consonants were mastered at age 3;00 - 3;05 years in MalE. The correct production of liquids will thus inhibit the use of liquid gliding.

The comparison of MalE and SE developmental phonological processes revealed that MalE speaking children are on a different timetable of development compared to SE speaking children. The use of deaffrication in older children is indicative of disorder in SE speaking children, but it is normal for MalE speaking children. Liquid gliding which is suppressed relatively later in SE was suppressed earlier in MalE speaking children. Intervention to treat liquid gliding might be inappropriately delayed if SE norms are used for MalE speaking children. Therefore, the use of norms developed for SE speaking children is not suitable for MalE speaking children. This further supports the need for developing local norms for MalE speaking children.

7.4 SUMMARY

The distinction between dialectal and developmental phonological processes is important in assessing phonological development of MalE speaking children. This is because some dialectal phonological processes are at risk of being treated as developmental. The findings of the present study will help SLPs to differentiate dialectal and developmental phonological processes used by MalE speaking children to avoid making inappropriate diagnoses. The majority of developmental phonological processes declined systematically across age groups, with the exception of final cluster reduction, final epenthesis and TH-fronting.

Variability was a common feature of normal phonological development within age groups and across age groups, as indicated by fluctuations in mean percentages of occurrence. SLPs should be aware that not all children at the same age level use the same phonological processes due to high variability in process use. A sex effect was not significant for any of the processes except for the use of unstressed syllable deletion.

MalE children irrespective of gender should show similar patterns of phonological process except for unstressed syllable deletion.

The present study also showed that developmental changes in phonological processes were still occurring until 7 years of age. The ages of suppression of phonological processes in MalE were both similar and different to SE. Special attention should be given to processes which were suppressed at different age levels to SE, for example, liquid gliding and deaffrication. Non-process errors which were not commonly reported in SE, but were frequent in MalE need to be taken into consideration when using phonological processes to assess children. Therefore, the need to develop local norms for MalE speaking children is again highlighted. In addition to this, SLPs need to be aware of methodological differences between studies when interpreting data on phonological processes to avoid misleading generalizations.

CHAPTER 8
SUMMARY AND CONCLUSION

8.0 INTRODUCTION

The aim of this thesis was to present normative data on MalE speaking Chinese children's phonological development by investigating the age of speech sound acquisition, speech sound accuracy and the use of phonological processes. This information is essential in identifying MalE speaking children with speech impairments. Two preliminary studies were done prior to the establishment of normative data for MalE speaking children. The first study gathered more information about current assessment practices for the phonological development of MalE speaking children. The second study gathered data on adults' pronunciations of MalE. This chapter summarizes the key findings from each of these studies. The clinical implications of the research findings are highlighted, the limitations are discussed and areas which need further investigation are proposed.

8.1 SUMMARY OF THESIS FINDINGS

Three investigations were carried out in this thesis.

First, the present thesis surveyed the perspectives of Malaysian speech-language pathologists (SLPs) about the use of articulation and phonological assessments in order to ascertain what they were using to evaluate the phonology of Malaysian children and whether they felt that these assessments were appropriate. A questionnaire was created and distributed to 38 Malaysian SLPs.

The following findings can be summarized.

1. The majority of Malaysian SLPs used informal articulation and phonological assessments to assess children in their clinics due to the lack of standardized tests for Malaysian children.
2. The majority of Malaysian SLPs felt that current articulation and phonological assessments were inadequate and insufficient in meeting their clinical needs.
3. Malaysian SLPs would prefer articulation and phonological assessments which could provide appropriate norms, culturally appropriate stimuli and high reliable results for assessing Malaysian children.
4. Malaysian SLPs urged the development of local phonological norms for Malaysian children.

The above findings demonstrated that Malaysian SLPs were concerned about the lack of appropriate articulation and phonological assessment tools for the Malaysian population which can lead to difficulty in identifying and treating clients with speech impairments. Therefore, this highlighted the need to develop local norms for Malaysian children. The current thesis developed a set of test stimuli which contained culturally appropriate and familiar vocabulary for Malaysian children. The design of the research also aimed to obtain highly reliable results by considering a large and representative number of children.

Second, the present thesis studied the dialectal features of MalE by considering adults' realizations. Adults' realizations served to identify a model of MalE dialectal features. This model was then used for scoring the assessment data of children in the third section of the thesis. The speech production of ten Malaysian English speaking Chinese undergraduate students was recorded. The speech sample was collected through single word reading. The findings of this second study revealed that:

1. Although MalE consonant and vowel inventories did not differ from SE, many realization patterns were different.
2. There were respectively 15 and 4 distinctive consonant and vowel realizations in MalE. The phonological features of consonants in MalE included final consonant devoicing, dental fricative avoidance, glottalization of stops, vocalization, substitution of /v/ with /w/, omission of /l/, rhoticity, medial consonant devoicing, consonant cluster reduction, deaspiration of voiceless stops, the use of syllabic /l/, affrication of /tr/, /dr/ and /str/, flapping, final stop devoicing and omission of past tense markers. The phonological features of vowels in MalE consisted of simplification of diphthongs, the use of full vowels for reduced vowels, shortening and lengthening of short vowels and deletion of unstressed syllables.
3. The consonant and vowel realizations in MalE were influenced by Mandarin Chinese, Chinese dialects and Malay that are used in addition to English in the community of Malaysia. For examples, the lack of long and short vowels in Mandarin Chinese and Malay led to lack of vowel length distinction in MalE.
4. There were 12 phonological patterns of adult MalE which converged with major developmental phonological processes exhibited by SE speaking children. For

example, devoicing of stops was similar to postvocalic devoicing; deaspiration of voiceless stops was akin to prevocalic voicing.

This study showed that many MalE consonants and vowels were realized differently in comparison to SE. The findings of the present study supported claims that MalE had its own linguistic identity which is substantially different from SE (Baskaran, 2004; Rajadurai, 2007). The identification of MalE dialectal features is important because some of the phonological patterns of MalE are identical with developmental phonological processes exhibited by SE speaking children. If MalE dialectal features are not considered, MalE speaking children might be diagnosed as having speech impairments. Therefore, knowledge of the phonological patterns of MalE is essential when assessing MalE speaking children. The findings of the second study were used as guidelines for the study of children's phonology which formed the third and major section of this thesis.

Third, the present thesis established local normative data in phonology for Chinese Malaysian children. A cross-sectional study was carried out on 264 MalE speaking Chinese children aged 3 to 7 years old. The speech sample was collected through single word picture naming. The normative data were presented in three major areas: age of speech sound acquisition, speech sound accuracy and phonological processes.

A) Age of Speech Sound Acquisition

1. The acquisition of MalE vowels was almost complete by age 3. The age of acquisition of MalE consonants and consonant clusters were wide-ranging (ranged from 3 to 7 years or older) and differed according to syllable position. For example, Figure 8.1 shows the ages of MalE consonant acquisition in SI and SF by taking methodological differences into consideration.

B) Speech Sound Accuracy

2. The speech sound accuracy in terms of Percentage of Consonants Correct (PCC), Percentage of Vowels Correct (PVC) and Percentage of Consonant Clusters Correct (PCCC) at different ages was determined when assessed with and without taking MalE dialectal features into consideration. PVC had the highest accuracy, followed by PCC and PCCC. All measures differed significantly when assessed with and without taking MalE dialectal features into consideration. Figure 8.2 shows the differences for PCC. The difference was sufficiently great that typically developing MalE children would have been diagnosed as having mild-moderate speech impairment.

3. There was a significant age effect in terms of PCC, PVC and PCCC, with older children performing better than younger children. However, no significant sex effect was found in terms of children's speech sound accuracy.
4. The accuracy of consonants according to different sound class (manner of articulation), syllable position and phonetic similarity at different ages were identified. The order of MalE consonant accuracy according to sound class from low to high was: affricates, fricatives, liquids, stops, nasals and glides. The accuracy of syllable-initial consonants in MalE was significantly higher than syllable-final consonants across all age groups. The accuracy of shared sounds was significantly higher than unshared sounds in MalE across all age groups.
5. Vowels accuracy differed significantly according to syllable type. Children's vowel accuracy was lower in PSWs than MSWs and DSWs across all age groups.
6. Consonant cluster accuracy was identified according to different syllable position, cluster category and number of cluster constituents. Final clusters were found to be produced more correctly than initial clusters in younger children. By contrast, older children showed higher accuracy of production in initial clusters than in final clusters. The overall order of consonant cluster accuracy according to cluster categories from high to low was: /s/ + C, C + /w/, C + /j/, C + /l/ and C + /r/. Two-element clusters consistently had higher accuracy than three-element clusters across the age groups.

C) Phonological Processes

7. A total of 15 dialectal and 12 developmental phonological processes exhibited by MalE speaking children were identified. Dialectal phonological processes had higher and consistent mean percentages of occurrence and standard deviation across age groups in comparison to developmental phonological processes. The majority of developmental phonological processes decreased with age. By contrast, the majority of dialectal processes did not decrease with age.
8. All developmental phonological processes were significantly correlated with age except for final cluster reduction, final epenthesis and TH-fronting. There were no significant sex differences for any phonological processes except for unstressed syllable deletion.

9. The age of suppression for developmental phonological processes was divided into two major categories: processes that were suppressed by the age of 3 years and those that persisted beyond 3 years. Stopping of affricates, velar fronting, unstressed syllable deletion, epenthesis, affrication and final consonant deletion were suppressed by 3 years of age. Phonological processes that persisted after 3 years of age included deaffrication, initial and final cluster reduction, cluster simplification, omission of plural markers, TH-fronting, palatal fronting, stopping of fricatives and liquid gliding.

Each of these measures (age of speech sound acquisition, speech sound accuracy and phonological processes) provide much-needed information for assessing phonological development of MalE speaking children and identifying speech disorders. They should be all used together when assessing phonological skills of children. SLPs need to take MalE dialectal features into consideration when deriving any of these measures.

The findings of speech sound accuracy and phonological processes demonstrated that sex effects were insignificant. Therefore, the same norms can be used for both female and male children during assessment and intervention. Older children showed more correct speech sound productions and less phonological process use than younger children. Variability occurred in both children's speech sound production and phonological process use, especially for the younger children. Therefore, SLPs should be aware of the degree to which typically developing children may differ in rate of phonological acquisition.

Cross-linguistic effects resulting from Mandarin Chinese and Malay clarified some of the acquisition differences between MalE and SE. The differences were mainly observed in syllable position, sound class, cluster category and shared and unshared sounds. For example, MalE children performed better in production of consonants in SI than in SF might be the influence of Mandarin Chinese and Malay. Mandarin Chinese and Malay only permit a small number of final consonants, leading to potential difficulty in mastering segmental and phonotactic aspects of English syllable-finally.

The age of phonemic acquisition of MalE consonants and consonant clusters differed according to different syllable positions. This result emphasizes that the age of phonemic acquisition of MalE consonants and consonant clusters needs to be specified according to syllable-initial and syllable-final positions rather than in the classical way of averaging two or three word positions together as is commonly done for older SE studies. The differences in phonological acquisition of MalE and SE imply that the norms of SE are not suitable to be used for MalE speaking children.

8.2 GENERAL DISCUSSION OF THESIS FINDINGS

It was hypothesized in the present study that Malaysian English children might be using phonetically similar sounds (shared sounds) between their three languages (English, Mandarin Chinese and Malay) to aid in the sequence of speech sound acquisition of MalE (Fabiano-Smith & Goldstein, 2010; Goldstein, Fabiano, & Iglesias, 2003). The current findings provide qualified support for the phonetic similarity hypothesis (Fabiano-Smith & Goldstein, 2010; Goldstein, Fabiano, & Iglesias, 2003). For instance, sounds that are shared and are acquired earlier include syllable-initial /s/, /l/ and /r/. Sounds that are not shared and are acquired later in MalE include syllable-initial /z/. However, the hypothesis of phonetic similarity alone is insufficient to explain the phonological development of MalE speaking children. This is because the influence of phonological conditions such as phonotactic constraints and phonetic context as well as syllable position should be taken into consideration. As can be seen from the findings, many consonants are acquired at different age levels according to syllable position. For instance, syllable-initial /tʃ/ was acquired at age 4 ½ years while syllable-final /tʃ/ was not acquired even at age 7 years. This indicates that phonetically similar sounds are not necessarily acquired at the same rate contrary to a simple interpretation of the phonetic similarity hypothesis. In addition to this, the /h/ (as in *grass<u>h</u>opper*) and /w/ (as in *sand<u>w</u>ich*) sounds which were sampled in SIWW were acquired later (4;00-4;06 years old), because these sounds were sampled in words with more complex phonetic environments, which make the sounds prone to errors. The exclusion of /h/ and /w/ in SIWW words lowers the age of acquisition of both sounds to 3;00-3;05 years old in the present study. The phonetic similarity hypothesis thus provides an initial indication of the sounds that are likely to be acquired earlier in the languages the child is acquiring. However, a detailed description of speech sounds produced in a variety of phonological contexts is necessary to fully understand the cross-linguistics effects of speech sound acquisition in English, Mandarin Chinese and Malay in MalE speaking children.

In addition to this, phonological frequency, which is not studied in the present study, might serve as a predictor for the speech sound acquisition sequence of shared sounds in MalE in addition to the phonetic similarity hypothesis. Frequency of occurrence of sounds in a language is often viewed as a factor related to linguistic complexity, such that sounds that occur frequently are viewed as less complex than those that are occur frequently (Greenberg, 1966; Trubetzkoy, 1939). An investigation of phoneme frequency could have improved the ability of the phonetic similarity hypothesis to predict the sequence of acquisition of shared and unshared sounds in English, Mandarin Chinese and Malay in the present study. Previous studies have found that frequently occurring sounds are produced with higher accuracy than sounds that are significantly less frequent. Indeed, Kirk and Demuth (2003) found that English-learning children mastered the more frequent coda clusters before the less frequent onset clusters. Likewise, high frequency stop + /s, z/ clusters were acquired earlier than less frequent phoneme combinations. However, phonological frequency analyses for Mandarin Chinese and Malay are not currently available. Further investigation to determine the effects of phoneme frequency in each language on the acquisition of shared sounds, cannot thus be carried out in the present thesis. However, the predictive capability of phonological frequency in English, Mandarin Chinese and Malay on the acquisition sequence of shared sounds should be examined in the future.

Due to the complex linguistic situation in Malaysia, Malaysian children are learning a variety of English (MalE) that has already been affected by both Mandarin Chinese and Malay, as is seen, for instance, in the glottalization of stops and simplification of final clusters. But at the same time, these children are also learning Mandarin Chinese and Malay, so these MalE features are reinforced for each generation. Although Mandarin Chinese and Malay are very different from English in terms of speech sound inventory and phonotactic structures, in the Malaysian context the difference is actually less because of the characteristics that have already been incorporated into MalE. Yip and Matthews (2007) found that there was an overlap between bilingual language development (Cantonese-English) and influence from the substrate language for syntax (e.g. Singapore Colloquial English). If similar effects occur for phonology, some MalE speaking children may produce the substrate feature (e.g. /θ/ realized as [t]) but others may produce the developmental feature (in this case [f] for /θ/) thus making analysis of MalE phonological development even more complex. Standard Mandarin Chinese was used as a benchmark in the present thesis for discussion of its impact on speech sound acquisition of MalE. However, given the possible differences that exist between Standard Mandarin Chinese and the variety of Mandarin spoken in Malaysia (Malaysian Mandarin), discussion of how Malaysian Mandarin influences MalE should be carefully considered. The material used in the present study such as Zhao (1995) and Hua (2002) were based on Standard Mandarin Chinese, which did not take the differences into consideration.

The adult study reported in Chapter 3 raised questions as to whether /θ/ and /ð/ were phonemes of MalE in that they were not used by all the participants. A similar question can be asked about the status of /v/ in that it is often produced as [w] by adults, and similarly acquired by children. Perceptual experiments would be necessary to establish the phonemic status of these sounds. There are two relatively straightforward ways of doing such experiments. Firstly, older MalE speaking children could be asked to distinguish between minimal pairs produced by a speaker who makes a phonemic distinction in words such as *vet* versus *wet* (for /v/ and /w/), *three* versus *tree* (for /θ/ versus /t/) and *there* versus *dare* (for /ð/ and /d/). Secondly they could be asked to read a list of words containing these phonemes and asked to identify their own productions when a randomized list was played back to them (Labov, 1994). Both of these tasks are likely to provide evidence as to whether these sounds are merged for MalE speaking children. Questions were also raised about vowel length. These can only be resolved by acoustic analysis. Acoustic analysis might also help indicate whether children who have apparently merged long and short vowels, or /θ/ and /ð/ or /v/ and /w/ still retained covert contrasts for these phonemes (Labov, 1994; Edwards & Beckman, 2008).

From Figure 8.1, the age of MalE consonant acquisition chart, it looks as though MalE speaking children are acquiring some consonants, such as /v/, /θ/ and /ð/, earlier than SE speaking children. This is because MalE children were granted correct production for attempts at productions which are variants that are acceptable in MalE. A study such as this, which used a MalE framework in the derivation of age of speech sound acquisition, may be somewhat confusing to some speech-language pathologists (SLPs) in that it indicates that MalE speaking children acquire these sounds earlier than SE speaking children. However, MalE speaking children vary their production of these sounds by either producing the SE speech sounds or MalE variants, depending on the model of MalE that they are learning. If MalE variants are not taken into consideration, MalE children's speech sound acquisition might be underestimated. If MalE variants are taken into consideration, one major problem potentially arises. MalE speaking children who are attempting the SE target, rather than the MalE variant, for speech sound like /v/, /θ/ and /ð/ are most likely to acquire these sounds later than the age of acquisition stated in Figure 8.1. This is because these sounds are phonetically dissimilar and not shared in Mandarin Chinese and Malay, so they are not likely to be acquired earlier. Therefore, SLPs must take extra care to determine the model of MalE the children are learning from.

8.3 CLINICAL IMPLICATIONS

A number of clinical implications can be derived from the present thesis.

i. The results of the present thesis emphasize the importance of describing MalE phonological acquisition by taking MalE dialectal features into consideration. The application of SE expectations to MalE speaking children is not valid for supporting assessment protocols for this population.
ii. A list of MalE dialectal features has been identified which could be used by speech-language pathologists when assessing MalE speaking children. Clear definitions of MalE dialectal features are important in helping SLPs to differentiate speech differences from true disorders.
iii. The present thesis provides reliable and representative normative data of MalE speaking Chinese children which could be used by Malaysian speech-language pathologists to make clinical decisions. This normative data provide information that should be useful in determining if a child's phonological development is within the normal range. If MalE speaking children perform differently from the norms provided, this may indicate delayed phonological development.
iv. The normative data in the present study will serve as the prerequisite to the eventual establishment of standardized articulation and phonological assessments for MalE speaking children.
v. Information of multiple aspects of phonological development is made available for SLPs. Data on age of speech sound acquisition, speech sound accuracy and phonological processes are provided. These sets of data provide a comprehensive picture of MalE speaking children's phonological development. When such information is combined, SLPs will have more data on which to base their decisions.

vi. The present thesis discusses the possible influences and interference patterns of Mandarin Chinese and Malay on the phonological acquisition of MalE speaking children. It is hoped that the methodological and theoretical issues explored in the present thesis will provide a framework for studies of phonological development of other varieties of MalE such as Malay-influenced MalE and Indian-influenced MalE as well as other dialectal English such as Singapore English.

vii. The normative data could be used as preliminary data for multilingual studies in the future. Hua & Dodd (2006) identified four stages in the research cycle for multilingual studies, with the first stage of the cycle being the identification of typical developmental patterns of children speaking a particular language. Therefore, normative data of typically children as provided here are needed before the developmental patterns of atypical children can be compared.

viii. The findings on the phonological acquisition of MalE speaking children help in understanding the developmental similarities and differences between MalE and SE. MalE speaking children do not develop in the same way as SE speaking children due to the interaction and interference between the phonological systems of the languages being learned. The findings highlighted that the SE norms should not be applied to MalE speaking children.

8.4 LIMITATIONS OF THE CURRENT RESEARCH

The present thesis is limited in several aspects that should be addressed in the future.

i. The small number of children in the youngest age group was a concern. This might affect the validity of results due to high individual variations.

ii. The speech samples of the present study were based on single word naming. Older children demonstrated approximately spontaneous naming for approximately 80% of the words where younger children spontaneously named less than 50% naming of the words. Children's responses towards certain target words were found to be different when children named them spontaneously or with imitation. Therefore, children's phonological skills as ascertained in this thesis might differ compared to their spontaneous connected speech samples.

iii. The normative data reported in this thesis did not reflect the true population of all Malaysian Chinese. This is because geographical diversity and socio-economic status were not representative of the Malaysian Chinese population.

Therefore, the normative data developed in the present thesis cannot be applied to all Malaysian Chinese children. SLPs may have to consider some factors when using this set of normative data. First, all of the children in the present study lived in the same speech community (Penang). Studies of other dialectal varieties of English such as African American Vernacular English and Spanish-influenced English have shown a regional influence in the exhibition of dialect features (Goldstein & Iglesias, 2001; Washington & Craig, 1992). Thus, it may necessary to collect speech samples from the child's peers and adults in the community in which the child lives if the dialectal variety of MalE in the present thesis does not fully described the child's dialect in his or her region. It is also important to note that these findings do not suggest that every child is using the same MalE dialectal features.

8.5 DIRECTIONS FOR FUTURE RESEARCH

Many issues for future research could be raised from the present thesis.

i. Future research could include testing of children beginning at younger ages and ending at older ages in order to assess more completely the mastery of speech sound production and developmental decline in process usage.
ii. A longitudinal study could be carried on MalE speaking children to complement the normative data in the cross-sectional study reported in the present study. As individual factors such as gender, socio-economic status, parents' educational background are stable over time in a longitudinal study, researchers could observe the interrelationship between age and phonological changes. Longitudinal studies provide a true depiction of children's phonological development. The extent which cross sectional results align with longitudinal data indicates the true "developmental function".
iii. There are three sub-varieties of MalE, which are Chinese-influenced MalE, Malay-influenced MalE and Indian-influenced MalE. However, the current research only considered Chinese-influenced MalE. Therefore, it would be worthwhile to study the phonological development of MalE speaking Malay and Indian children in the future.
iv. The developmental patterns of Mandarin Chinese and Malay acquired by MalE speaking children should be studied in order to observe the interaction among the three developing phonological systems.

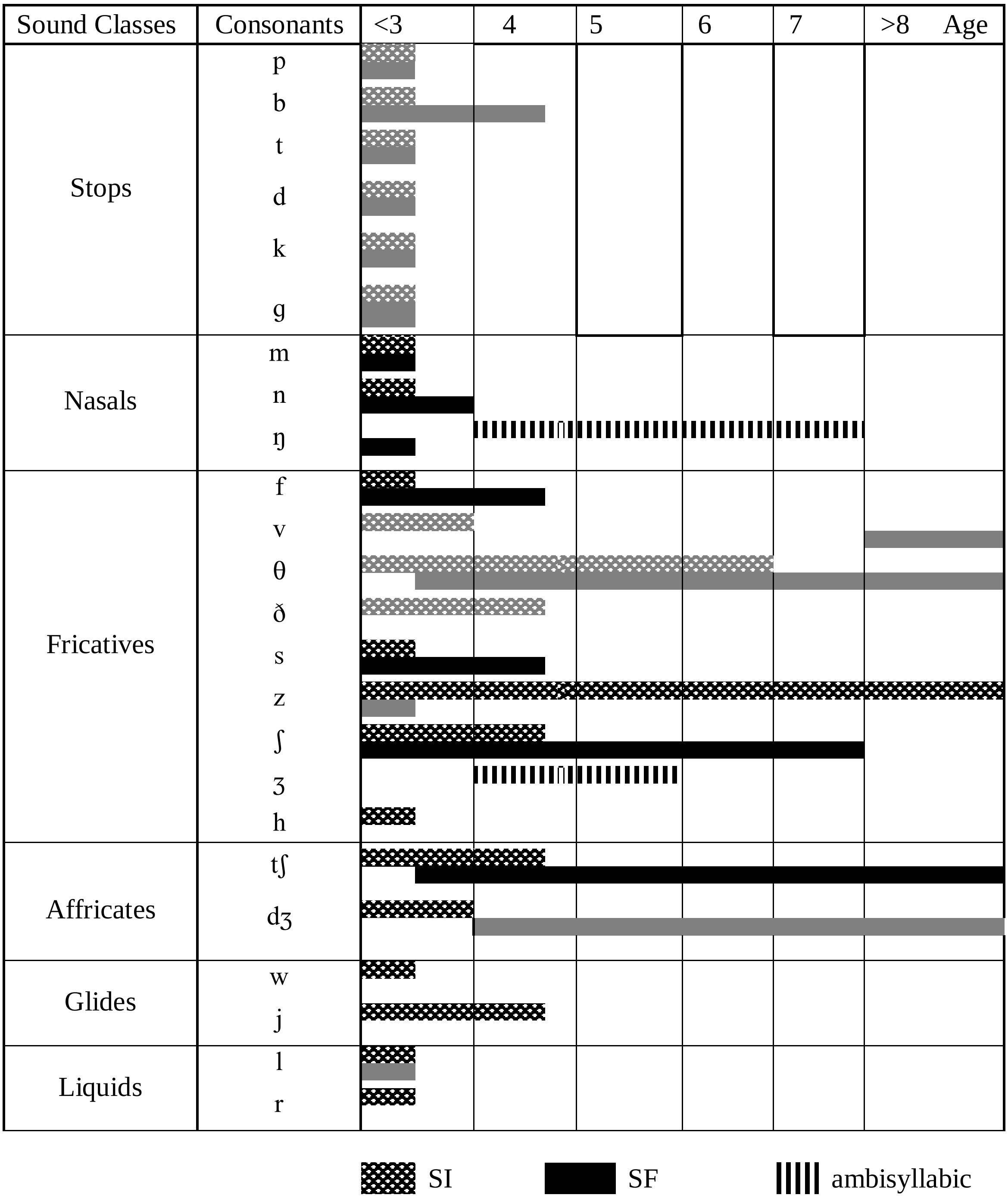
v. An acoustic analysis could be done to accurately describe the differences of some MalE phonological features, for example, the distinction between long and short vowels and some consonant realizations. Acoustic analysis could also provide some insight into any of the possible "reduction" or deletion processes. In addition to this, acoustic analysis could help to reveal covert contrasts in some MalE realizations (Edwards and Beckman, 2008). For instance, a contrast between /v/ and /w/ which might not be perceptible to the author in the present study might be revealed under detailed acoustic analysis.

vi. In order to reveal representation versus production of MalE children, especially for consonants that are produced with significant variants in MalE, such as /v/, /θ/ and /ð/, perceptual experiments should be carried. Older MalE speaking children could be asked to distinguish between minimal pairs such as *vet* versus *wet* for /v/ and /w/ distinction, *three* versus *tree* for /θ/ versus /t/ distinction and *there* versus *dare* for /ð/ and /d/. At the same time, they could be asked to read a list of the same words to see if they correctly identified their own productions when a randomized list was played back to them (Labov, 1994). Both of these tasks are likely to provide evidence as to whether these sounds are merged for MalE speaking children.

8.6 CONCLUSIONS

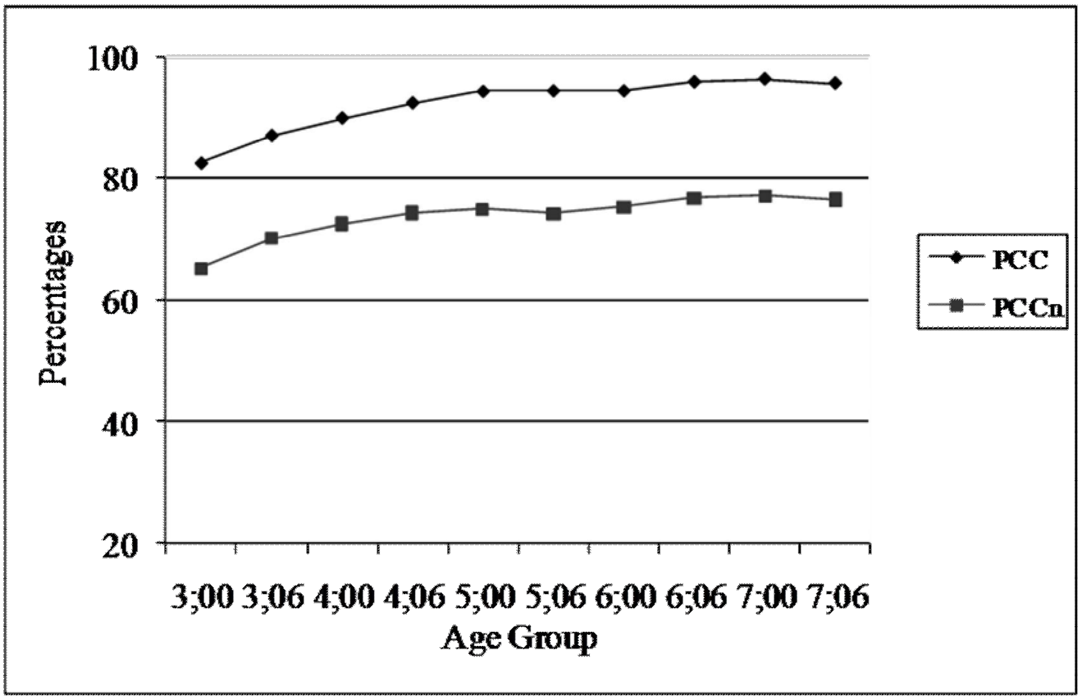
The present thesis considered the perspectives of Malaysian speech-language pathologists in developing phonological normative data that are suitable to be used to assess MalE speaking children. A model of MalE speaking adults' realizations was developed and used when analyzing phonological data of MalE speaking children. This thesis provides reliable normative data from MalE speaking children by considering multiple aspects of children's speech sound development (age of speech sound acquisition, speech sound accuracy and phonological processes). However, it is important that the normative data are used cautiously. The factors and comments discussed in this thesis should be always taken into account when using the norms.

Figure 8.1: Revised Age of MalE Consonant Acquisition in SI and SF Taking Methodological Differences into Consideration



Notes:
- Graphic presentation was adapted from Sander (1972).
- The solid bar corresponding to each sound begins at the median age of customary production and ends at an age of mastery.
- SI refers to SIWI (syllable-initial word-initial) and SIWW (syllable-initial within-word)
- SF refers to SFWF (syllable-final word-final) and SFWW (syllable-final within-word)
- /ʒ/ and /ŋ/ refer only to words assessed in ambisyllabic position like *treasure* for /ʒ/ and *singing* for /ŋ/.
- The age of acquisition of /p/, /w/ and /h/ reduced to 3;00-3;05 when they were not sampled in SFWW or SIWW.
- The age of acquisition of /b/ reduced to 4;00-4;05 when it excluded unfamiliar word like *web*.
- The bars in grey indicate phonemes produced with significant variants which are acceptable in MalE.

Figure 8.2: Display of PCC with (♦) and without (■) MalE Dialectal Features Taken into Consideration



REFERENCES

Adler, S. (1993). *Multicultural communication skills in the classroom*. Boston: Allyn & Bacon.

Alisjahbana, T. S. (1957). *Dari Perjuangan dan Pertumbuhan Bahasa Indonesia*. Jakarta: Pustaka Rakyat.

Allen, G. D., & Hawkins, S. (1980). Phonological rhythm: Definition and development. In G. H. Yeni-Komshian, J. F. Kavanagh & C. A. Ferguson (Eds.), *Child Phonology* (Vol. 1). New York: Academic.

Amran, H. (1984). *Intonasi dalam hubungannya dengan sintaksis Bahasa Indonesia*. Penerbit Djambatan, Jakarta. (PhD dissertayion, University of Michigan, 1967).

Arlt, P. B., & Goodban, M. T. (1976). A Comparative Study of articulation Acquisition as Based on a Study of 240 Normals, Aged Three to Six. *Language, Speech, & Hearing Services in Schools, VII*, 173-180.

Armstrong, S., & Ainley, M. (1988). *South Tyneside Assessment of Phonology (STAP)*. Northumberland: STASS Publications.

ASHA (1983). Social dialect position paper. *American Speech-language and Hearing Association*

ASHA (1995). American Speech-language and Hearing Association.

ASHA (2003). American Speech-language and Hearing Association.

ASHA (2008). American Speech-language and Hearing Association.

Asmah, H. O. (1977). *The Phonological Diversity of the Malay Dialects*. Kuala Lumpur: Dewan Bahasa dan Pustaka.

Asmah, H. O. (2004). *The Encyclopedia of Malaysia: Languages & Literature*. Kuala Lumpur: Editions Didier Millet.

Augustin, J. (1982). Regional Standards of English in Peninsular Malaysia. In J. Pride (Ed.), *New Englishes* (pp. 249-258). Massachusetts: Newbury House.

Austin, D., & Shriberg, L. (1997). *Lifespan reference data for ten measures of articulation competence using the Speech Disorders Classification System (SDCS) (Technical Report No. 3)*. Paper presented at the Madison, WI: Phonology Project.

Awang Sariyan (2004). *Teras pendidikan Bahasa Melayu: Asas pegangan guru*. Bentong, Pahang: PTS Publications Sdn Bhd.

Bankson, N. W., & Bernthal, J. E. (1981). *Articulation Disorders*. Prentice-Hall: Englewood Cliffs, N.J.

Bankson, N. W., & Bernthal, J. E. (1990). *Bankson-Bernthal Test of Phonology*. Austin, Texas: Pro-ed.

Bankson, N. W., & Bernthal, J. E. (1996). Phonological Assessment Procedures *Articulation and Phonological Disorders* (fourth ed., pp. 270-398). Boston: Allyn and Bacon.

Bao, Z. M. (1998). The Sounds of Singapore English. In J. A. Foley et al. (Eds.), *English in New Cultural Contexts: Reflections from Singapore* (pp. 152-174). Singapore: Oxford University Press.

Baskaran, L. (1994). The Malaysian English Mosaic. *English Today 37, 10*(1), 27-32.

Baskaran, L. (2004). Malaysian English: Phonology. In B. Kortmann & E. W. Schneider (Eds.), *A Handbook of varieties of English: A Multimedia Reference Tools* (pp. 1034-1046). Berlin; New York: Mouton de Gruyter.

Bauer, L., & Warren, P. (2004). New Zealand English: phonology. In E. Schneider, B. Kortmann, K. Burridge, R. Mesthrie & C. Upton (Eds.), *A Handbook of Varieties of English* (Vol. 1 Phonology, pp. 593-594). Berlin: NY: Mouton de Gruyter.

Bautista, M. L. S., & Gonzalez, A. B. (2006). Southeast Asian Englishes. In B. B. Kachru, Y. Kachru & C. L. Nelson (Eds.), *The Handbook of World Englishes* (pp. 130-144). Maden, USA; Oxford, UK; Victoria, Australia: Blackwell Publishing.

Bickerton, D. (1976). Dynamics of a Creole System. *Language, 52*(4), 992-997.

Bland-Stewart, L. M. (2003). Phonetic Inventories and Phonological Patterns of African American Two-Year-Olds: A Preliminary Investigation. *Communication Disorders Quarterly, 24*(3), 109-120.

Bleile, K. M. (1989). A note on vowel patterns in two normally developing children. *Clinical Linguistics and Phonetics, 3*(2), 203-212.

Bolton, K. (2008). English in Asia, Asian Englishes, and the Issue of Proficiency. *English Today 94, 24*(2), 3-13.

Boudahmane, K., Manta, M., Antoine, F., Galliano, S., & Barras, C. (1998). Transcriber. http://trans.sourceforge.net/.

Bowling, A. (1997). *Research Methods in Health*. Buckingham: Open University Press.

Brown, A. (1988a). The staccato effect in the pronunciation of English in Malaysia and Singapore. In J. Foley (Ed.), *New Englishes: the Case of Singapore* (pp. 115-128). Singapore: Singapore University Press.

Brown, A. (1988b). Vowel differences between Received Pronunciation and the English of Malaysia and Singapore: Which ones really matter? In J. Foley (Ed.), *New Englishes: the Case of Singapore* (pp. 129-147). Singapore: Singapore University Press.

Burt, L., Holm, A., & Dodd, B. (1999). Phonological awareness skills of 4-year-old British children: An assessment and developmental data. *International Journal of Language and Communication Disorders, 34,* 311-335.

Butcher, A. (1989). The Use and Abuses of Phonological Assessment. . *Child Language Teaching and Therapy, 5*, 262-276.

Chen, P. (1999). *Modern Chinese: History and Sociolinguistics*. New York: Cambridge University Press.

Chirlian, N. S., & Sharpley, C. F. (1982). Children's Articulation Development: Some regional Differences. *Australian Journal of Human Communication Disorders, 10*(2), 23-30.

Chen, P. (1999). *Modern Chinese: History and Sociolinguistics*. New York: Cambridge University Press.

Cheng, C. C. (1973). *A Synchronic Phonology of Mandarin Chinese*. Paris: Mouton & Co. N. V.

Chin, T. (2006). *Sound Systems of Mandarin Chinese and English: A Comparison*. Muenchen: LINCOM GmbH.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Hillsdale: NJ: Lawrence Erlbaum.

Cole, P., & Taylor, O. (1990). Performance of working class African-American children on three tests of ariculation. *Language, Speech, & Hearing Services in Schools, 21*, 171-176.

Chomsky, N. & Halle, M. (1968). *The Sound Pattern of English*. Harper Row, New York.

Crystal, D. (1987). Towards a 'bucket' theory of language disability: taking account of interaction between linguistic levels. *Clinical Linguistics & Phonetics*(1), 7-22.

Curtis, J., & Hardy, J. (1959). A phonetic study of misarticulation of */r/. Journal of Speech, Language, and Hearing Research, 2,* 244-257.

Damico, J. (1991). Descriptive assessment of communicative ability in limited English proficient children. In E. Hamayan & J. Damico (Eds.), *Limiting bias in the assessment of bilingual students* (pp. 157-217). Austin: Pro-Ed.

Davis, B. L. (1998). Consistency of consonant patterns by word position. *Clinical Linguistics & Phonetics, 12*(4), 329-348.

Davis, B. L., & MacNeilage, P. F. (1990). Acquisition of Correct Vowel Production: A Quantitative Case Study. *Journal of Speech, Language, and Hearing Research, 33*(1), 16-27.

DeHouwer, A. (1995). Bilingual language acquisition. In P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language* (pp. 219-250). Malden: MA: Blackwell.

Demirezen, M. (2006). Flapping in North American Pronunciation: Case 1 The Change of /t/ and /d/ into [D] in Pronunciation. *Journal of Language and Linguistic Studies, 2*(1), 87-100.

Department of Statistics. (2010). Malaysian Population. Retrieved from http://www.statistics.gov.my/

Deterding, D. (2003). An instrumental study of the monophthong vowels of Singapore English. *English World-Wide, 24*(1), 1-16.

Deterding, D. (2007). Phonetics and Phonology *Singapore English* (pp. 12-39). Edinburgh: Edinburgh University Press.

Deterding, D. (2008). The Pronunciation of Hong Kong English. *English World-Wide, 29*(2), 148-175.

Deterding, D., & Poedjosoedarmo, G. (1998). The sounds of English: Phonetics and phonology for English teachers in Southeast Asia. Singapore: Simon & Schuster.

Di-Paolo, M., & Faber, A. (1990). Phonation differences and the phonetic content of the tense-lax contrast in Utah English. *Language Variation and Change* (2), 155-204.

Dodd, B. (1995). Children's Acquisition of Phonology *Differential Diagnosis & Treatment of Children with Speech Disorder* (pp. 21-48). London: Whurr Publishers Ltd.

Dodd, B., & McCormack, P. (1995). A Model of Speech Processing for Differential Diagnosis of Phonological Disorders. *Differential Diagnosis & Treatment of Children with Speech Disorder* (pp. 65-89). London: Whurr Publishers Ltd.

Dodd, B., Holm, A., Hua, Z., & Crosbie, S. (2003). Phonological development: A normative study of British English-speaking children. *Clinical Linguistics and Phonetics, 17*(8), 617-643.

Dodd, B., Hua, Z., Crosbie, S., Holm, A., & Ozanne, A. (2002). *Diagnostic Evaluation of Articulation and Phonology*. London: The Psychological Corporation.

Donegan, P. (2002). Normal vowel development. In M. J. Ball & F. E. Gibbon (Eds.), *Vowel Disorders* (pp. 1-35). Boston: Butterworth-Heinemann.

Döpke, S. (2000). Generation of and retraction from cross-linguistically motivated structures in bilingual first language acquisition. *Bilingualism: Language & Cognition, 3*(3), 209-226.

Duanmu, S. (2000). *The Phonology of Standard Chinese*. New York: Oxford University Press.

DuBois, E. M., & Bernthal, J. E. (1978). A Comparison of Three Methods for Obtaining Articulatory Responses. *Journal of Speech and Hearing Disorders 43*, 295-305.

Dunn, C., & Davis, B. L. (1983). Phonological process occurrence in phonologically disordered children. *Applied Psycholinguistics, 4*, 187-207.

Durian, D. (2004). /s/-retraction and /l/-vocalization realization in Columbus AAVE Speech: An impressionistic sociolinguistic analysis. *Unpublished manuscript, the Ohio State University*.

Dyson, A. T. (1988). Phonetic Inventories of 2- and 3- Year-Old Children. *Journal of Speech & Hearing Disorders, 53*, 89-93.

Dyson, A. T., & Paden, E. P. (1983). Some phonological acquisition strategies used by two-year-olds. *Journal of Childhood Communication Disorders, 7*, 6-18.

Edwards, J., & Beckman, M. E. (2008). Methodological questions in studying consonant acquisition. *Clinical Linguistics and Phonetics, 22*, 937-956.

Edwards, M. L., & Shriberg, L. D. (1983). *Phonology: Application in Communicative Disorders*. San Diego, California: College-Hill Press.

Elbert, M., & Gierut, J. A. (1986). Assessing Productive Phonological Knowledge: Overview *Handbook of Clinical Phonology, Approaches to Assessment and Treatment*. London: Taylor & Francis Ltd.

Encyclopedia of Mental Disorders (2007). Retrieved from http://www.minddisorders.com/.

Fabiano-Smith, L., & Goldstein, B. A. (2010). Phonological Acquisition in Bilingual Spanish–English Speaking Children. *Journal of Speech, Language, and Hearing Research, 53*, 160-178.

Faircloth, M. A., & Faircloth, S. R. (1970). An analysis of the articulatory behavior of a speech-defective child in connected speech and in isolated-word responses. *Journal of Speech and Hearing Disorders, XXXV*, 51-61.

Farwell, C. B. (1976). Some strategies in the early production of fricatives. *Papers and reports on child language development, 12*(97-104).

Ferguson, C. A. (1977). New directions in phonological theory: Language acquisition and universals research. In R. W. Cole (Ed.), *Current issues in linguistic theory* (pp. 247-299). Bloomington, IN: Indiana University Press.

Finley, R. (1999). The simple way to create surveys. www.surveymonkey.com

Fisher, H. B., & Logemann, J. A. (1971). *The Fisher-Logemann Test of Articulation Competence*. Boston: Houghton Mifflin.

Flege, J. (1981). The phonological basis of foreign accent: A hypothesis. *TESOL Quarterly, 15*, 443-455.

Flege, E. J. (1987). The production of "new" and "similar" phones in a foreign language: Evidence for the effects of equivalence classification. *Journal of Phonetics, 15*, 161-180.

Flege, J. (1995). Second-language speech learning: theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: theoretical and methodological issues*. Timonium, MD: York Press.

French, A. (1989). The systematic acquisition of word forms by a child during the first fifty word stage. *Journal of Child Language, 16*, 69-90.

Gallagher, T. M., & Shriner, T. H. (1975). Articulatory inconsistencies in the speech of normal children. *Journal of Speech, Language, and Hearing Research, 18*, 168-175.

Gard, A., Gilman, L., & Garman, J. (1993). *PRO-ED Speech and Language Development Chart* (2nd ed.). Austin, Texas: Pro-ed.

Gay, L. R. (1995). *Education research: Competencies for analysis and application* (5th ed.). Upper Saddle River: NJ: Merrill/Prentice Hall.

Genesee, F., Paradis, J., & Crago, M. (2004). *Dual language development and disorders: A handbook on bilingualism and second language learning*. Baltimore, MD: Brookes.

Gibbon, F., Shockey, L., & Reid, J. (1992). Description and treatment of abnormal vowels in a phonologically disordered child. *Child Language Teaching & Therapy, 8*(1), 30-59.

Giegerich, H. J. (1992). *English Phonology: An Introduction*. New York: Cambridge University Press.

Gildersleeve-Neumann, C., Kester, E., Davis, B., & Pena, E. (2008). English speech sound development in preschool-aged children from bilingual Spanish-English environments. *Language, Speech and Hearing Services in the Schools, 39*, 314-328.

Gill, S. K. (1999). Standards and emerging linguistic realities in the Malaysian workplace. *World Englishes, 18*(2), 215.

Gimson, A. C. (Ed.). (1989). *An Introduction to the Pronunciation of English*. New York: Routledge, Chapman and Hall, Inc.

Goffman, L., & Malin, C. (1999). Metrical effects of speech movements in children and adults. *Journal of Speech, Language, and Hearing Research, 42*, 1003-1015.

Goldman, R., & Fristoe, M. (2000). *Goldman Fristoe 2: Test of Articulation.* Circle Pines: American Guidance Service.

Goldman, R., Fristoe, M., & Williams, K. (2000). *Goldman Fristoe 2: Test of Articulation*. Paper presented at the ASHA Annual Convention.

Goldstein, B. A. (2001). Assessing Phonological Skills in Hispanic/Latino Children. *Seminars in Speech and Language, 22*(1), 39-49.

Goldstein, B. A., & Iglesias, A. (1996a). Phonological patterns in normally developing Spanish-speaking 3- and 4-year-olds of Puerto Rican. *Language, Speech, & Hearing Services in Schools, 27*(1), 82.

Goldstein, B. A., & Iglesias, A. (1996b). Phonological patterns in Puerto Rican Spanish-speaking children with phonological disorders. *Journal of Communication Disorders, 29*(5), 367-387.

Goldstein, B. A., & Iglesias, A. (2001). The effect of dialect on phonological analysis: Evidence from Spanish-speaking children. *American Journal of Speech - Language Pathology, 10*(4), 394-406.

Goldstein, B. A., Fabiano, L., & Washington, P. S. (2005). Phonological Skills in Predominantly English-Speaking, Predominantly Spanish-Speaking, and Spanish- English Bilingual Children. *Language, Speech, & Hearing Services in Schools, 36*(3), 201-218.

Goldstein, B., & Cintrón, P. (2001). An investigation of phonological skills in Puerto Rican Spanish-speaking 2-year-olds *Clinical Linguistics & Phonetics, 15*(5), 343 - 361.

Goldstein, B., & Washington, P. S. (2001). An Initial Investigation of Phonological Patterns in Typically Developing 4-Year-Old Spanish-English Bilingual Children. *Language, Speech, & Hearing Services in Schools, 32*(3), 153-164.

Goldstein, B., Fabiano, L., & Iglesias, A. (2003). *Phonological representation in bilingual Spanish-English speaking children*. Paper presented at the 4th International Symposium on Bilingualism.

Goldstein, B., Fabiano, L., & Iglesias, A. (2004). Spontaneous and Imitated Productions in Spanish-Speaking Children With Phonological Disorders. *Language, Speech, & Hearing Services in Schools, 35*(1), 5-15.

Gomez, C., & Reason, R. (2002). Cross-Linguistic Transfer of Phonological Skills: A Malaysian Perspective. *Dyslexia, 8,* 22-33.

Gordon, E., & Maclagan, M. A. (2001). Capturing a sound change: a real time study over 15 years of the NEAR/SQUARE diphthong merger in New Zealand English. *Australian Journal of Linguistics, 21* (2), 215-238.

Greenberg, J. H. (1966). *Language universals, with special reference to feature hierarchies*. The Hague, the Nertherlands: Mouton.

Greenlee, M. (1974). Interacting Processes in the Child's Acquisition of Stop-liquid Clusters. *Papers and Reports on Child Language Development, 7*, 85-100.

Gregersen, F., & Pedersen, I. (1991). *The Copenhagen study in urban sociolinguistics*. Copenhagen: C.A. Reitzels Forlag.

Grossman, H. (1995). *Teaching in a diverse society*. Boston: Allyn & Bacon.

Grunwell, P. (1981). The development of phonology: a descriptive profile. *First Language, iii*, 161-191.

Grunwell, P. (1982). *Clinical Phonology* Rockville, Md: Aspen Systems Corporation.

Grunwell, P. (1985). *Phonological Assessment of Child Speech (PACS)*. Windson, UK: NFER-Nelson.

Grunwell, P., & Yavas, M. (1988). Phonotactc restrictions in disordered child phonology: A case study. *Clinical Linguistics & Phonetics, 2*(1), 1-16.

Gupta, A. F. (1994). *The Step-Tongue: Children's English in Singapore*. Clevedon: Multilingual Matters.

Gupta, A. F., Brebner, C., & Yeo, H. C. (1998). Developmental assessments in speech-language therapy in Singapore. *Asia Pacific Journal of Speech Language and Hearing, 3:1*, 17-28.

Habick, T. (1980). *Sound change in Farmer city: A sociolinguistic study based on acoustic data.* University of Illinois at Urbana-Champaign dissertation.

Haelsig, P. C., & Madison, C. L. (1986). A Study of Phonological Processes Exhibited by 3-, 4-, and 5-Year-Old Children. *Language, Speech, and Hearing Services in Schools, 17*(2), 107-114.

Hargrove, P. M. (1982). Misarticulated Vowels: A Case Study. *Language, Speech, & Hearing Services in Schools, 13,* 86-95.

Hashim, A., & Lodge, K. R. (1988). The phonological processes of Malay: a preliminary statement. *UEA Papers in Linguistics, 28,* 1-28.

Hassan, A. (2005). Language Planning in Malaysia: The first hundred years. *English Today 84, 21*(4).

Haugen, E. (1956). *Bilingualism in the Americas: A bibliography and research guide* (Vol. 26). University: University of Alabama Press.

Hodson, B. W. (1980). *The assessment of phonological processes.* Danville, IL: Interstate Inc.

Hodson, B., & Paden, E. P. (1981). Phonological processes which characterize unintelligible and intelligible speech in early childhood. *Journal of Speech & Hearing Disorders, 46*, 369-373.

Holm, A., & Dodd, B. (1999). A longitudinal study of the phonological development of two Cantonese-English bilingual children. *Applied Psycholinguistics, 20,* 349-376.

Horvath, B. M., & Horvath, R. J. (2001). A multilocality study of a sound change in progress: The case of /l/ vocalization in New Zealand and Australian English. *Language Variation and Change, 13*, 37-57.

Hua, Z. (2002). *Phonological development in specific contexts: Studies of Chinese-speaking Children*. Clevedon: Multilingual Matters Ltd.

Hua, Z., & Dodd, B. (2006). *Phonological development and disorders in children: A multilingual perspective*. Clevedon: Multilingual Matters Ltd.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal abilities: a meta-analysis. *Psychological Bulletin, 104,* 53-69.

Iglesias, A., & Anderson, N. (1993). Dialectal variations. In J. E. Berthal & N. W. Bankson (Eds.), *Articulation and phonological disorders* (3rd ed., pp. 147-161). New Jersey: Prentice Hall.

Ingram, D. (1976). *Phonological disability in young children*. New York: American Elsevier Publishing.

Ingram, D. (1981). *Procedures for the Phonological Analysis of Children's Language*. Baltimore: University Park Press.

Ingram, D., Christensen, L., Veach, S., & Webster, B. (1980). The acquisition of word-initial fricatives and affricates in English by children between 2 and 6 years. In G. H. Yeni-Komshian, J. F. Kavanagh & C. A. Ferguson (Eds.), *Child Phonology: Production* (pp. 169-192). New York: Academic Press.

James, D. (1997). The Need to Use Polysyllabic Words in the Assessment and Analysis of Speech. *Australian Communication Quarterly*, 6-8.

James, D. G. H. (2001). An item analysis of Australian English words for an articulation and phonological test for children aged 2 to 7 years. *Clinical Linguistics and Phonetics, 15*(6), 457-485.

James, D. G. H. (2001). Use of phonological processes in Australian children ages 2 to 7,11 years. *Advances in Speech-language Pathology, 3*(2), 109-127.

James, D. G. H., van Doorn, J., & Mcleod, S. (2001). *Vowels production in mono-, bi- and polysyllabic words in children aged 3;00 to 7;11 years.* Paper presented at the Speech Pathology Australia National Conference.

James, D. G. H., van Doorn, J., & McLeod, S. (2002). Segment production in mono-, di- and polysyllabic words in children aged 3-7 years. In F. Windsor, L. Kelly & N. Hewlett (Eds.), *Themes in Clinical Phonetics and Linguistics* (pp. 287 - 298). Mahwah, NJ: Lawrence Erlbaum.

James, D. G. H., van Doorn, J., & McLeod, S. (2008). Patterns of consonant deletion in typically developing children aged 3 to 7 years. *International Journal of Speech-Language Pathology, 10*(3), 179-192.

James, D., McCormack, P., & Butcher, A. (1999). *Children's use of phonological processes in the age range of five to seven years.* Paper presented at the Speech Pathology Australia National Conference, Melbourne.

Janda, R. D., & Joseph, B. D. (2003). Reconsidering the canons of sound change: towards a "big bang" theory. In B. Blake & K. Burridge (Eds.), *Historical linguistics 2001: Selected papers from the 15th international conference on* *historical linguistics, Melbourne, 13-17 August 2001* (pp. 205-219). Amsterdam: John Benjamins.

Jenkins, J. (2001). *The Phonology of English as an international language*. Oxford: Oxford University Press.

Jones, D. (Ed.). (2003). *English Pronouncing Dictionary* Cambridge: Cambridge University Press.

Joseph, P. T. (2007). Phonological Acquisition Among Malaysian English Child Speakers of Indian Descent. *Jurnal Sains Kesihatan Malaysia, 4*(2), 13-26.

Kachru, B. B. (1985). Standards, codification and sociolinguistic realism: The English language in the outer circle. In R. Quirk & H. G. Widdowson (Eds.), *English in the world: Teaching and learning the language and literatures* (pp. 11-30). Cambridge, England: Cambridge University Press.

Kachru, B. B. (1986). *The Alchemy of English: The Spread, Functions and Models of Non-native Englishes*. Oxford: Pergamon Press.

Kachru, B. B. (1988). Teaching World Englishes. *ERIC/CLL News Bulletin, 12*(1), 3-4.

Kachru, B. B. (1992). Teaching World Englishes. In B. B. Kachru (Ed.), *The other tongue: English across cultures* (2nd ed., pp. 355-365). Urbana, IL: University of Illinois Press.

Kahler, H. (1956). *Grammarik der Bahasa Indonesia*. Weisbaden: Otto Harrossowitz.

Kayser, H. (1989). Speech and language assessment of Spanish-English speaking children. *Language, Speech, & Hearing Service in Schools, 20*, 226-241.

Kehoe, M., Trujillo, C., & Lleo, C. (2001). *Bilingual phonological acquisition: An analysis of syllable structure and VOT.* Paper presented at the Proceedings of the colloquium on structure, acquisition and change of grammars: Phonological and syntactic aspects, Universitat Hamburg.

Kenney, K. W., & Prather, E. M. (1986). Articulation Development in Preschool Children: Consistency of Productions. *Journal of Speech & Hearing Research, 29*, 29-36.

Kenny, K. W., Prather, E. M., Mooney, M. A., & Jeruzal, N. C. (1984). Comparisons among Three Articulation Sampling Procedures with Preschool Children. *Journal of Speech & Hearing Research, 27*, 226-231.

Kent, R. D. (1982). Contextual facilitation of correct sound production. *Language, Speech and Hearing Services in the Schools, 13*, 66-76.

Keshavarz, M. H., & Ingram, D. (2002). The early phonological development of a Farsi-English bilingual child. *The International Journal of Bilingualism*, 6, 255-269.

Khan, L. M. L. (1982). A Review of 16 Major Phonological Processes. *Language, Speech, & Hearing Services in Schools, 13*, 77-85.

Kilminster, M. G. E., & Laird, E. M. (1978). Articulation Development In Children Aged Three to Nine Years. *Australian Journal of Human Communication Disorders, 6*(1), 23-30.

Kirk, C., & Demuth, K. (2003, November). *Onset/ coda asymmetries in the acquisition of clusters.* Proceedings from the 27th Annual Boston University Conference on Language, Boston, MA.

Kirkpatrick, A. (2007). The Communicative Strategies of ASEAN Speakers of English as a Lingua Franca. In D. Prescott, A. Kirkpatrick, I. Martin & A. Hashim (Eds.), *English in Southeast Asia Literacies, Literatures and Varieties.* NewCastle, UK: Cambridge Scholars Press.

Klein, H. B. (1981). Productive Strategies for the Pronunciation of Early Polysyllabic Lexical Items. *Journal of Speech & Hearing Research, 24*(September), 389-405.

Klein, H. B. (1985). Relationship between early pronunciation processes and later pronunciation skill. *Journal of Speech and Hearing Disorders, 50*, 150-156.

Labov, W. (1972). *Sociolinguistic Features.* Philadelphia: University of Pennsylvania Press.

Labov, W. (1984). Field methods of the project on linguistic change and variation. In J. Baugh & J. Sherzer (Eds.), *Language in use: readings in sociolinguistics.* Eaglewood Cliffs: Prentice-Hall.

Labov, W. (1994). *Principles of Linguistic Change, Volume 1: Internal factors.* Oxford: Blackwell Publishers.

Lance, D. M., & Howie, S. M. (1997). Spectrographic analysis of English phonemes and allophones. In J. S. Kenyon (Ed.), *American pronunciation* (pp. 267-344). Michigan: George Wahr.

Laver, J. (1993). Principles of Phonetics. *Language Arts & Disciplines*, 707.

Lawrence, W. (2000). /str/->/ʃtr/: assimilation at a distance? *American Speech, 75*, 82-87.

Lee, T., Zhu, J., & Ballard, E. (2010). *Speech development of Mandarin-English Bilingual Children in New Zealand: Findings for children aged 7;00-7;11*. Paper presented at the NZSTA Biennial Conference, Wellington, New Zealand.

Levey, S., & Cruz, D. (2004). The Discrimination of English Vowels by Bilingual Spanish/English and Monolingual English Speakers. *Contemporary Issues in Communication Science and Disorders, 31*, 162-172.

Lian, C. H. T., & Abdullah, S. (2001). The Education and Practice of Speech-Language Pathologists in Malaysia. [Print]. *american Journal of Speech - Language Pathology, 10*, 3-9.

Lim, H. W., Howard, S., & Wells, B. (2008, June). *Simultaneous consonant acquisition in three languages: a cross-sectional study of Mandarin, English and Malay*. Paper presented at the 12th Congress of the International Clinical Phonetics and Linguistics Association, Istanbul.

Lin, L., & Johnson, C. J. (2010). Phonological patterns in Mandarin-English bilingual children. *Clinical Linguistics & Phonetics, 24*(4-5), 369-386.

Lingwall, J. B. (1988). Evaluation of the requirements for the Certificates of Clinical Competence in speech language pathology and audiology. *Asha, 30 (9)*, 75-78.

Lisker, L., & Abramson, A. S. (1971). Distinctive features and laryngeal control. *Language, 47*(4), 767-783.

Lleó, C. (2006). The Acquisition of Prosodic Word Structures in Spanish by Monolingual and Spanish-German Bilingual Children. *Language and Speech, 49*, 205.

Lodge, K. (2009). *A critical introduction to phonetics* New York: Continuum International Publishing Group.

Long, S. H., & Fey, M. E. (1996). *Computerized Profiling (Version 9.0)*. Cleveland: Case Western Reserve University.

Low, H. M. (2006). *Multilingualism in early childhood and the challenges faced by speech-language pathologists in Malaysia*. Paper presented at the National Early Childhood Intervention Conference.

Lund, N., & Duchan, J. (1993). *Assessing children's language in naturalistic contexts* (3rd ed.). Englewood Cliffs: NJ: Prentice Hall.

Maclagan, M. A. (2000). Where are we going in our language? New Zealand English today. *NZ Journal of Speech-Language Therapy, 53-54*, 14-20.

Mann, D. M., & Hodson, B. W. (1994). Spanish-speaking Children's Phonologies: Assessment and Remediation of Disorders. *Seminars in Speech and Language, 15*(2), 137-148.

Markman, E. M. (1989). *Categorization and naming in children: Problems of induction.* Cambridge, MA: MIT Press.

MASH (2007). Directory of MASH Members. http://www.mash.org.my/.

McArthur, T. (1987). The English Language. *English Today, 11*, 9-13.

McCormack, P., & Knighton, T. (1996). *Gender differences in the speech development of two and a half year old children.* Paper presented at the Sixth Australian International Conference on Speech Science and Technology, Adelaide.

McGregor, K., & Reilly, R. (1998). *Dialect density in young African American English speakers.* Paper presented at the Annual Convention of the American Speech-Language-Hearing Association.

McKay, I. (1978). *Introducing Practical Phonetics*. Boston, MA: Little Brown.

McLeod, S. (1997). Sampling Consonant Clusters: Four Procedures Designed for Australian Children. *Australian Communication Quarterly*, 9-12.

McLeod, S. (2005, November). *The International Perspective on Speech Acquisition.* Paper presented at the American Speech-Language-Hearing Convention, San Diego.

McLeod, S., & Arciuli, J. (2009). School-aged children's production of /s/ and /r/ consonant clusters. *Folia Phoniatrica et Logopaedica, 61,* 336-341.

McLeod, S., & Hewett, S. (2008). Variability in the Production of Words Containing Consonant Clusters by Typical 2- and 3-Year-Old Children.

Mcleod, S., & McKinnon, D. H. (2007). Prevalence of communication disorders compared with other learning needs in 14500 primary and secondary school students. *International Journal of Language and Communication Disorders, 42*(1), 37-59.

McLeod, S., Doorn, J. v., & Reed, V. (2002). Typological description of the normal acquisition of consonant clusters. In F. Windsor, L. Kelly & N. Hewlett (Eds.), *Themes in Clinical Phonetics and Linguistics.* Mahwah, NJ: Lawrence Erlbaum.

Mcleod, S., van Doorn, J., & Reed, V. A. (1997). Realizations of consonant clusters by children with phonological impairment. *Clinical Linguistics & Phonetics, 11*(2), 85-113.

McLeod, S., van Doorn, J., & Reed, V. A. (2001a). Consonant Cluster Development in Two-Year-Olds: General Trends and Individual Difference. *Journal of Speech, Language & Hearing Research, 44*(5), 1144-1171.

McLeod, S., van Doorn, J., & Reed, V. A. (2001b). Normal Acquisition of Consonant Clusters. *American Journal of Speech-Language Pathology, 10*, 99-110.

McReynolds, L. V., & Elbert, M. (1981a). Criteria for Phonological Process Analysis. *Journal of Speech & Hearing Disorders, 46*, 191-196.

McReynolds, L. V., & Elbert, M. (1981b). Generalization of correct articulation in clusters. *Applied Psycholinguistics, 2*, 119-132.

Milroy, L. (1987). *Observing and Analysing Natural Language*. Oxford: Blackwell.

Mohanan, K. (1992). Describing the phonology of non-native varieties of a language. *World Englishes, 11*, 111-128.

Morais, E. (2001). Lectal Varieties of Malaysian English. In V. Ooi (Ed.), *Evolving Identities: The English Language in Singapore and Malaysia* (pp. 33-52). Singapore: Times Academic Press.

Morrison, J. A., & Shriberg, L. D. (1992). Articulation Testing Versus Conversational Speech Sampling. *Journal of Speech & Hearing Research. 35*, 259-273.

Mowrer, D. E., & Burger, S. (1991). A Comparative Analysis of Phonological Acquisition of Consonants in the Speech of 21/2 - 6 Year-Old Xhosa and English-speaking Children. *Clinical Linguistics & Phonetics, 5*(2), 139-164.

Moyle, J. (2005). The New Zealand Articulation Test Norms Project. *New Zealand Journal of Speech-Language Therapy, 60*, 61-74.

Nair-Venugopal, S. (2000). English, Identity and the Malaysian Workplace. *World Englishes, 19*(2), 205-213.

NIDCD (2000). *National Institute of Deafness and Other Communicative Disorders.*

Norman, J. (1988). *Chinese*. Great Britain: Cambridge University Press.

Oetting, J. B., & Garrity, A. W. (2006). Variation within Dialects: A Case of Cajun/Creole Influence Within Child SAAE and SWE. *Journal of Speech, Language & Hearing Research, 49*(1), 16-26.

Owens, R. E. (2007). *Language Development: An Introduction* (7th ed.): Allyn & Bacon, Inc.

Ozanne, A. (1995). The search for developmental verbal apraxia. In B. Dodd (Ed.), *Differential Diagnosis and Treatment of Children with Speech Disorder* (pp. 91-109). London: Whurr.

Pakir, A. (1993). *The English Language in Singapore: Standards and Norms*. Singapore: UniPress for Singapore Association for Applied Linguistics.

Paradis, J., & Genesee, F. (1996). Syntactic acquisition in bilingual children: Autonomous or independent? *Studies in Second Language Acquisition, 18*, 1-25.

Paschall, L. (1983). Development at 18 months. In J. V. Irwin & S. P. Wong (Eds.), *Phonological development in children: 18 to 72 months* (pp. 73-81). Carbondale: Southern Illinois University Press.

Pearson, F. B., Lewedeg, V. S., & Oller, D. K. (1997). The relation of input factors to lexical learning by bilingual infants. *Applied Psycholinguistics, 18*, 41-58.

Perez, E. (1994). Phonological Differences among Speakers of Spanish-Influenced English. In J. E. Bernthal & N. W. Bankson (Eds.), *Child Phonology: Characteristics, Assessment, and Intervention with Special Populations* (pp. 245-254). New York: Thieme Medical Publishers, Inc.

Platt, J. T. (1977). "The Creoloid" as a special type of interlanguage. *Interlanguage Studies Bulletin 2*(3), 22-38.

Platt, J. T., & Weber, H. (1980). *English in Singapore and Malaysia: Status, Features and Functions*. Kuala Lumpur: Oxford University Press.

Platt, J., Weber, H., & Ho, M. L. (1983). *Singapore and Malaysia English*. Amsterdam; Philadelphia: John Benjamins.

Platt, J., Weber, H., & Ho, M. L. (1984). *The New Englishes*. London: Routledge and Kegan Paul.

Pollock, K. E. (2002). Identification of Vowel Errors: Methodological Issues and Preliminary Data from the Memphis Vowel Project. In M. J. Ball & F. E. Gibbon (Eds.), *Vowel Disorders* (pp. 83-113). Boston: Butterworth-Heinemann.

Pollock, K. E., & Berni, M. C. (2003). Incidence of non-rhotic vowel errors in children: Data from the Memphis Vowel Project. *Clinical Linguistics & Phonetics, 17*(4), 393 - 401.

Pollock, K. E., & Keiser, N. J. (1990). An examination of vowel errors in phonologically disordered children. *Clinical Linguistics and Phonetics, 4*(2), 161-178.

Poole, I. (1934). Genetic Development of articulation of consonant sounds in speech. *Elementary English Review, 11*, 159-161.

Poplack, S. (1980). Deletion and disambiguation in Puerto Rican Spanish. *Language, 56*(2), 371-385.

Population and Housing Census (2000). Population Distribution and Basic Demographic Characteristics Report. Retrieved from http://www.statistics.gov.my/.

Porter, J. H., & Hodson, B. W. (2001). Collaborating to Obtain Phonological Acquisition Data for Local Schools. *Language, Speech, & Hearing Services in Schools, 32*(3), 165-171.

Powell, T. W. (1993). *Phonetic subgroups of American English consonant clusters*. Paper presented at the Third Congress of the International Clinical Phonetics and Linguistics Association.

Powell, T. W. (1994). A Clinical Screening Procedure for Assessing Consonant Cluster Production. *American Journal of Speech-Language Pathology, 4*(1), 59-65.

Prater, R. J., & Swift, R. W. (1982). Phonological Process development with MLU-referenced guidelines. *Journal of Communication Disorders, 15*(5), 395-410.

Prather, E. M., Hedrick, D. L., & Kern, C. A. (1974). Articulation Development in Children Aged Two to Four Years. *Journal of Speech & Hearing Disorders, XL*, 179-191.

Preisser, D. A., Hodson, B. W., & Paden, E. P. (1988). Developmental Phonology: 18-29 Months. *Journal of Speech & Hearing Disorders, 53*, 125-130.

Preshous, A. (2001). Where you going ah? *English Today, 17*(01), 46-53.

Rajadurai, J. (2007). Sociolinguistic perspectives on variation in non-native varieties of English: The case of Malaysian English. *Multilingua, 26*(04), 409-426.

Richards, J. C., & Tay, M. W. J. (1977). The la Particle in Singapore-English. In W. Crewe (Ed.), *English Language in Singapore* (pp. 68-82). Singapore: Eastern Universities Press.

Robb, M. P., & Bleile, K. M. (1994). Consonant Inventories of Young Children from 8 to 25 Months. *Clinical Linguistics & Phonetics, 8*(4), 295-320.

Roberts, J. E., Burchinal, M., & Footo, M. M. (1990). Phonological process decline from 2 to 8 years. *Journal of Communication Disorders, 23*(3), 205-217.

Salameh, E., Nettelbladt, U., & Norlin, K. (2003). Assessing phonologies in bilingual Swedish-Arabic children with and without language impairment. *Child Language Teaching and Therapy, 19*(3), 338.

Sander, E. K. (1972). When Are Speech Sounds Learned? *Journal of Speech & Hearing Disorders, XXXVII*, 55-63.

Schiff, N. B., & Ventry, I. M. (1976). Communication problems in hearing children of deaf parents. *Journal of Speech & Hearing Disorders, 41*, 348-358.

Schneider, E. W. (2003). Evolutionary patterns of New Englishes and the special case of Malaysian English. *Asian Englishes, 6*(2), 44-63.

Schneider, E. W. (2007). *Postcolonial English: Varieties around the World*. Cambridge: Cambridge University Press.

Schwartz, R. G., Leonard, L. B., Folger, M. K., & Wilcox, M. J. (1980). Early phonological behaviour in normal-speaking and language disordered children: evidence for a synergistic view of linguistic disorders. *Journal of Speech and Hearing Disorders, XLV*, 357-377.

Seymour, H. N., & Seymour, C. M. (1981). Black English And Standard American English Contrasts In Consonantal Development of Four And Five-Year Old Children. *Journal of Speech and Hearing Disorders*, 274-280.

Shapiro, M. (1995). A case of distant assimilation: /str/->/ʃtr/. *American Speech, 70*, 101-107.

Shea, T., & Blodgett, E. (1994, November). *Spontaneous and imitated productions in preschoolers with phonological disorders*. Paper presented at the annual convention of the American Speech-Language-Hearing Association, New Orleans, LA.

Shriberg, L. D. (1993). Four New Speech and Prosody-Voice Measures for Genetics Research and Other Studies in Developmental Phonological Disorders. *Journal of Speech Hearing Research, 36*(1), 105-140.

Shriberg, L. D., & Austin, D. (1997). The Percentage of Consonants Correct (PCC) metric: Extensions and reliability data. *Journal of Speech, Language & Hearing Research, 40*(4), 708.

Shriberg, L. D., & Kwiatkowski, J. (1980). *Natural Processes Analysis: A Procedure for Phonological Analysis of Continuous Speech Samples*. New York: NY: John Wiley & Sons.

Shriberg, L. D., & Kwiatkowski, J. (1982). Phonological Disorders III: A Procedure for Assessing Severity of Involvement. *Journal of Speech & Hearing Disorders, 47*, 256-270.

Shriberg, L. D., & Kwiatkowski, J. (1994). Developmental Phonological Disorders: A clinical profile. *Journal of Speech and Hearing Research, 37*, 1000-1126.

Smit, A. B. (1986). Ages of Speech Sound Acquisition: Comparisons and Critiques of Several Normative Studies. *Language Speech Hearing Service Schools, 17*(3), 175-186.

Smit, A. B. (1993a). Phonologic Error Distributions in the Iowa-Nebraska Articulation Norms Project: Word-Initial Consonant Clusters. *Journal of Speech & Hearing Research, 36*(5), 931-947.

Smit, A. B. (1993b). Phonologic Error Distributions in the Iowa-Nebraska Articulation Norms Project: Consonant Singletons. *Journal of Speech & Hearing Research, 36*, 533-547.

Smit, A. B., Hand, L., Bernthal, J. E., Freilinger, J. J., & Bird, A. (1990). The Iowa Articulation Norms Project and It's Nebraska Replication. *Journal of Speech & Hearing Disorders, 55*, 779-798.

Smith, N. V. (1974). The acquisition of phonological skills in children. *British Journal of Disorders of Communication, 9*, 17-23.

Stampe, D. (1969). *The acquisition of phonetic representation*. Paper presented at the Fifth Regional Meeting of the Chicago Linguistic Society.

Stampe, D. (1979). A Dissertation on Natural Phonology. Bloomington: IULC.

Stoel-Gammon, C. (1985). Phonetic Inventories, 15-24 Months: A Longitudinal Study. *Journal of Speech & Hearing Research, 28*, 505-512.

Stoel-Gammon, C. (1987). Phonological skills of 2-Year-Olds. *Language, Speech, & Hearing Services in Schools, 18*, 312-322.

Stoel-Gammon, C. (1991). Normal and disordered phonology in two-year-olds. *Topic in Language Disorders*, *11*, 21-32.

Stoel-Gammon, C., & Dunn, C. (1985). *Normal and disordered phonology in children*. Austin, Texas: Pro-ed.

Stoel-Gammon, C., & Herrington, P. B. (1990). Vowel systems of normally developing and phonologically disordered children. *Clinical Linguistics and Phonetics, 4*(2), 145-160.

Tan, P. K. W. (1998). Malay Loan Words across Different Dialects of English. *English Today, 14*(4), 44-50.

Taylor, O. L., & Payne, K. T. (1983). Culturally valid testing: a proactive approach. *Topics in Language Disorders*, 8-20.

Templin, M. (1957). *Certain language skills in children, their development and interrelationships*. Minneapolis: University of Minnesota Press.

Terrell, S. L., Battle, D. E., & Grantham, R. B. (1998). African American Cultures (466, Trans.). In D. E. Battle (Ed.), *Communication Disorders in Multicultural populations* (2nd ed., pp. 31-71). Boston: Butterworth-Heinemann.

Terrell, T. (1981). Current trends in the investigation of Cuban and Puerto Rican phonology. In J. Amastae & Elias-Olivares (Eds.), *Spanish in the United States: Sociolinguistic aspects* (pp. 47-70). Cambridge, England: Cambridge University Press.

Thavisak, A. (2002). *Malay Dialects in Thailand.* Paper presented at The 2nd International Symposium on Language Speech and Hearing Science, Kuala Lumpur.

Tongue, R. K. (1979). *The English of Singapore and Malaysia* (2nd ed.). Singapore: Eastern Universities Press.

Trubetzkoy, N. S. (1939). *Grundzüge der phonologie*. Prague, Czech Republic: Travaux du cercle linguistique de Prague 7.

Trudgill, P. (1974). *The social differentiation of English in Norwich*. Cambridge: Cambridge University Press.

van Dort, S. (2005). Issues and innovations in clinical education: A perspective from Malaysia. *International Journal of Speech-Language Pathology, 7*(3), 170-172.

Vardi, I. (1991). *Phonological Profile for Hearing Impaired Test.* Perth: Edith Cowan University.

Vaughn-Cooke, F. (1986). Lexical diffusion: evidence from a decreolizing variety of Black English. In M. Montgomery & B. G (Eds.), *Language variety in the south* (pp. 111-130). Tuscaloosa: University of Alabama Press.

Vihman, M. (1992). Early syllables and the construction of phonology. In C. A. Ferguson, L. Menn & C. Stoel-Gammon (Eds.), *Phonological development: Models, Research, Implications* (pp. 393-422). Maryland: York Press.

Vihman, M. M., & Greenlee, M. (1987). Individual differences in phonological development: Age one and three years. *Journal of Speech & Hearing Research, 30*, 503-521.

Waring, R., Fisher, J., & Atkin, N. (2001). *The Articulation Survey: Putting Numbers to It.* Paper presented at the Proceedings of the 2001 Speech Pathology Australia National Conference.

Washington, J. A., & Craig, H. K. (1992). Articulation test performances of low-income African-American preschoolers with communication impairments. *Language, Speech, & Hearing Services in Schools, 23,* 201-207.

Watson, M. M., & Scukanec, G. P. (1997a). Phonological changes in the speech of two-year-olds: A longitudinal investigation. *Infant-toddler Intervention, 7*(1), 67-77.

Watson, M. M., & Scukanec, G. P. (1997b). Profiling the phonological abilities of 2-year-olds: a longitudinal investigation. *Child Language Teaching & Therapy, 13,* 3-14.

Waxman, S. R., & Namy, L. L. (1997). Challenging the notion of a thematic preference in young children. *Developmental Psychology, 33,* 555-567.

Weiner, F. F. (1979). *Phonological Process Analysis (PPA)*. Baltimore: University Park Press.

Weinreich, U. (1953). *Languages in contact.* The Hague: Mouton.

Weismer, G. (1980). Control of the voicing distinction for intervocalic stops and fricatives: Some data and theoretical considerations. *Journal of Phonetics, 8,* 427-438.

Wellman, B., Case, I., Mengert, I., & Bradbury, D. (1931). Speech sounds of young children. *University of Iowa Studies in Child Welfare, 5,* 1-82.

Wells, J. C. (1982). Accents of English: An Introduction. *Language Arts & Disciplines*, 297.

Wells, J. C. (1990). Syllabification and allophony. In S. Ramsaran (Ed.), *Studies in the pronunciation of English* (pp. 76-86). London and New York: Routledge.

Wells, J. C. (2000). *Longman Pronunciation Dictionary* (2nd ed.). Harlow: Pearson Education Limited.

Wells, J. C., & Colson, G. (1971). *Practical Phonetics*. London: Pitman Publishing.

Wells, W. (1982). *Accents of English*. Cambridge, UK: Cambridge University Press.

Wilcox, L. D., & Anderson, R. T. (1998). Distinguishing between phonological difference and disorder in children who speak African-American Vernacular English: An experimental testing instrument. *Journal of Communication Disorders, 31*(4), 315-335.

Williams, F. (1972). *Language and Speech: Introductory Perspectives.* Englewood Cliffs: Prentice Hall.

Winitz, H. (1959). Language skills of male and female kindergarten children. *Journal of Speech, Language, and Hearing Research, 2,* 377-386.

Wolfram, W. (1983). Test interpretation and sociolinguistic differences. *Topics in Language Disorders, 3*(3), 21-34.

Wolfram, W. (1994). The Phonology of a Sociocultural Variety: The Case of African American Vernacular English (AAVE). In J. E. Bernthal & N. W. Bankson (Eds.), *Child Phonology: Characteristics, Assessment, and Intervention with Special Populations* (pp. 227-244). New York: Thieme Medical Publishers, Inc.

Wolk, L., & Meisler, A. W. (1998). Phonological assessment: A systematic comparison of conversation and picture naming. *Journal of Communication Disorders, 31*(4), 291-313.

Worthley, W. J. (1981). *Sourcebook of Articulation Learning Activities.* Boston: Little, Brown and Company Inc.

Wyatt, T. A. (1995). Language development in African American English child speech. *Linguistics and Education, 7*(1), 7-22.

Yavas, M., & Goldstein, B. (1998). Phonological assessment and treatment of bilingual speakers. *American Journal of Speech - Language Pathology, 7*(2), 49-60.

Yip, V., & Matthews, S. (2007). *The bilingual child: Early development and language contact.* Cambridge: Cambridge University Press.

Young, E. C. (1987). The effects of treatment on consonant cluster and weak syllable reduction processes in misarticulating children. *Language, Speech and Hearing Services in the Schools, 18,* 20-33.

Young, E. C. (1991). An analysis of young children's ability to produce multisyllabic English nouns. *Clinical Linguistics & Phonetics, 5*(4), 297-316.

Young, E. C. (1995). An Analysis of A Treatment Approach for Phonological Errors in Polysyllabic Words. *Clinical Linguistics & Phonetics, 9*(1), 59-77.

Zhao, A. D. W. (1995). *The pedagogical issues and coping strategies of Chinese adult students at the University of Auckland.*, University of Auckland, Auckland.

Zuraidah, M. D., Knowles, G., & Yong, J. (2008). How words can be misleading: A study of syllable timing and "stress" in Malay. *The Linguistics Journal, 3*(2), 66-81.

Appendix A

Survey on Assessment of Articulation and Phonology Used by Speech-Language Pathologists in Malaysia

NOTE: You are invited to participate in the research project entitled **"The Phonological Development of Malaysian English Speaking Children**: **A Normative study".** This survey is designed as part of my PhD study with the aim to investigate Speech-language Pathologists' Perception of Articulation and Phonological Assessments in Malaysia.

The questionnaire is anonymous. You will not be identified as a participant without your consent. You may withdraw your participation, including withdrawal of any information you have provided, until your questionnaire has been added to the others collected. Because it is anonymous, it cannot be retrieved after that. By completing the questionnaire, it will be understood that you have consented to participate in the project and that you consent to publication of the results of the project with the understanding that anonymity will be preserved.

Instructions: Please (/) accordingly for section A.

A. BACKGROUND INFORMATION

Gender:
☐ Male
☐ Female

Ethnicity :
☐ Malay
☐ Chinese
☐ Indian
☐ Eurasian
☐ Other (Please state: ___________)

Setting of practice:
☐ Government hospital
☐ Private hospital
☐ Private clinic
☐ Non-profit Government Organization
☐ Special school
☐ Early intervention centre
☐ Other: _____________

Qualification:
☐ Diploma
☐ Degree
☐ Master
☐ PhD
☐ Other _________

Years of practice:
□ 0–2
□ 3–5
□ 6–8
□ 9–10
□ > 10

B. QUESTIONNAIRE

Instructions: Please (/) accordingly for section B.

1. When is the last time you saw a client with Articulation/Phonology disorder?
□ Recently
□ 1 year
□ 2 years
□ 3 years
□ more than 3 years

2. Do you use a standardized English Articulation / Phonology assessment?
□ Yes
□ No

If yes, please select the most commonly used English Articulation/Phonology Assessment/s in your clinic? (Please mark all that apply)
□ Arizona Articulation Proficiency Scale: Revised (AAPS-R)
□ A Screening Deep Test of Articulation (ASDTA)
□ Assessment of Phonological Processes: Revised (APP-R)
□ Bankson-Bernthal Test of Phonology (BBTOP)
□ Clinical Assessment of Articulation and Phonology (CAAP)
□ Daz Roberts' Test of Articulation (DRTOA)
□ Evaluation of Articulation And Phonology (DEAP)
□ Fisher-Logemann Test of Articulation Competence (FLTA)
□ Goldman-Fristoe Test of Articulation (GFTA)
□ Goldman-Fristoe Test of Articulation (GFTA2)
□ Hodson Assessment of Phonological Patterns (HAPP-3)
□ Khan-Lewis Phonological Analysis (KLPA-2)
□ Newcastle Speech Assessment (NSA)
□ PACS Pictures
□ Phonological Process Analysis (PPA)
□ Photo Articulation Test (PAT)
□ Queensland Articulation Test (QAT)
□ Screening Test For Developmental Apraxia Of Speech (STDAS)
□ Smit-Hand Articulation And Phonology Evaluation (SHAPE)
□ South Tyneside Assessment Of Phonology (STAP)
□ Templin-Darley Test of Articulation (TDTA)
□ Weiss Comprehensive Articulation Test (WCAT)
□ Other (Please specify) ____________________________________

3. Do you use an informal English Articulation / Phonology assessment?
□ Yes
□ No

If yes, please select the informal assessment/s used in your clinic. (Please mark all that apply)
 Self-developed and customized single word test
 Story telling
 Picture naming
 Reciting numbers, alphabets, and rhymes
 Conversation
 Reading
 Other (Please specify) ___________________________

4. Do you use both the standardized and the informal Articulation / Phonology assessments on the same client?
 Yes
 No

If yes, please state the reason/s: ____

5. If you are not using standardized assessment, please indicate the reason/s. The following are some of the reasons therapists may choose not to use a standardized test. Please order them in terms of priority, from 1 (most important) to 7 (least important).

Lack of representativeness & reliability of results (e.g., inappropriate norms and scores)	( )
Time consuming	( )
Not clinically friendly (e.g., complicated procedures, scoring and analysis)	( )
Inappropriate vocabulary	( )
Culturally inappropriate stimulus/pictures	( )
No access to standardized assessments	( )
Other (Please specify) __________________________________	( )

6. In your opinion, what are the most important aspects of a standardized assessment? Please order them in terms of priority, from 1 (most important) to 7 (least important).

Appropriate norms and developmental data	( )
Culturally appropriate pictures	( )
Strongly familiar vocabulary	( )
High reliability of results	( )
Simple procedures, scoring and analysis	( )
Easy access	( )
Other (Please specify) ___________________________________	( )

7. Please refer to the questions below.
a) Do you modify the standardized assessments?
 Yes
 No

If yes, please state why and how in the box provided below.

b) Do you feel that the lack of a standardized articulation/phonological assessment on Malaysian population/norms has resulted in inaccurate diagnosis or intervention?
☐ Yes
☐ No

Please state your reason/s in the box provided below.

c) Is the use of informal assessments of articulation/phonology sufficient to elicit accurate diagnosis and plan intervention?
☐ Yes
☐ No

Please state your reason/s in the box provided below.

8. Do you feel that there is a strong need to collect phonological developmental data in English as well as develop English articulation and phonology assessment for Malaysian-speaking children?
☐ Yes
☐ No

9. Generally, what are the values of developing English articulation and phonology assessment for Malaysian-speaking children instead of using assessments developed in another western country? Please order them in terms of priority, from 1 (most important) to 5 (least important).

Able to describe normal speech development for Malaysian children by looking into features of Malaysian English	( )
Able to recognize sociocultural factors (e.g., ethnicity, language background, and etc.)	( )
Able to provide cross-linguistic effects that affect the speech development	( )
Able to provide culturally appropriate stimulus (pictures and words)	( )
Other (please specify) ______________________________	( )

10. Please give your valued feedback on your expectation of a suitable English articulation and phonology assessment for Malaysia-speaking children. Please also feel free to write any other comments or suggestions that will help in my thesis.
THANK YOU.

____

____

Appendix B

Word List for Assessing Speech Production of Malaysian English speaking Chinese Adults

aeroplane
alligator
am
ambulance
ball
balloon
banana
beach
bed
behind
belt
bicycle
bird
birthday
blue
book
box
boy
bread
bridge
brother
bus
butterfly
cage
camera
carrot
cat
cats
caterpillar
chair
chick
chicks
chicken
clock
computer
cook
cooking
cow
crab
cucumber
deer
dinosaur
dog
dogs
dolphin
dragon
drum
duck
eat
egg
elephant
eyes
father
fence
finger
fish
fishing
five
flower
foot
fork
four
frog
giraffe
girl
glove
gloves
go
goat
grandmother
grasshopper
green
guitar
hair
hammer
hand
hanger
hat
helicopter
hippopotam
us
hospital
house
ice
ill
jam
jar
juice
jumped
kicked
kitchen
knee
knife
ladder
lamp
laughed
leg
lift
lizard
low
lunch
magic
mask
milk
money
moo
moon
mother
motorcycle
mouse
mouth
music
nail
new
nose
nothing
octopus
off
oink
on
orange
oven
paint
papaya
pear
pencil
pig
pillow
pink
plate
played
policeman
potato
prawn
present
pyjamas
quack
radio
red
refrigerator
ring
rocket
row
sandwich
school
scissors
screw
sea
seesaw
seven
sheep
shelf
shoe
shoulder
singing
skirt
slide
smoke
snail
sock
sofa
spider
splash
spoon
spray
square
star
strawberry
string
student
sun
swing
teacher
teddy bear
teeth
telephone
television
thank you
there
thief
this
three
thumb
tiger
tissue
tomato
tongue
toy
treasure
tree
twinkle
umbrella
up
vacuum
cleaner
vase
vegetable
vest
washing
machine
watch
watermelon
web
whistle
yellow
yo-yo
zebra
zip
zoo

Appendix C

Information Letter for Teachers

Dear Principal and Teachers,

We would like to invite children in your centre to participate in a PhD research study entitled **"The Phonological Development of Malaysian English Speaking Children: A Normative study"** conducted by Department of Communication Disorders at the University of Canterbury, New Zealand. The aim of this project is to establish norms and investigate the phonological or speech development of typically developing Malaysian English Speaking Chinese aged from 3 to 7 years old.

We are looking for typically developing children with no history of speech, language and communication delay, hearing loss, sensory or neurological impairment. We need 300 children who are predominantly English speaking. In order to get children who meet our inclusion criteria, a *parental questionnaire* will be distributed to parents who are interested in the study.

In this study, children will be asked to name some single word items on picture cards in English. The production of these children will be recorded in audio, in order to facilitate researcher transcription. The duration of their participation in the session ranges from 15 to 30 minutes, depending on children's motivation and cooperation.

This study is very important, as it will be a useful guideline and an appropriate reference for all childcare professions in Malaysia such as speech-language pathologists, teachers, parents, linguists and child specialists in Malaysia to look into the phonological development of Malaysian children. Therefore, children with articulation or phonological disorder will be identified and diagnosed appropriately.

This study is planned to commence in December 2007. A qualified speech-language pathologist, Phoon Hooi San will carry out the research under the supervision of Associate Professor Dr. Margaret Maclagan.

If you have any further enquiries, please do not hesitate to contact me at mobile phone: 012-585 2207 (Malaysia), 0064 3 364 2987 ext 7337 (New Zealand) or by emailing hsp20@student.canterbury.ac.nz or my supervisor at telephone no: 0064 3 364 2987 7083 (New Zealand) or email: margaret.maclagan@canterbury.ac.nz. We will be pleased to discuss any concerns you may have about participation in the project.

Attached you will find an additional *information letter* and *parental questionnaire* that will be sent out to the parents of the participating children.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Prepared by,

PHOON HOOI SAN
PhD Student
Communication Disorders Department
University Of Canterbury
New Zealand

Supervised by,

DR. MARGARET MACLAGAN
Associate Professor & Supervisor
Communication Disorders Department
University Of Canterbury
New Zealand

Appendix D

Teachers' Questionnaire

Instruction: Please circle or fill in the appropriate answer.

CHILD'S PERSONAL PROFILE

Name of Child	: ____________	Gender	: M / F
Date of birth	: ____________	Chronological age	: ________________
School Name	: ____________	Grade/ Class	: ________________
Name of Teacher	: ___________	Medium of Language Used in School	: English / Chinese / Malay /Mixed (Please specify): __________

A) SOCIAL HISTORY

Instruction: Please circle the appropriate answer.

1	Do you think the child has speech and language problems?	Yes	No
2	Do you think the child has academic or learning problems?	Yes	No
3	Do you think the child has behavioural or social problems?	Yes	No
4	Do you think the child has physical problems?	Yes	No

B) LANGUAGE USAGE & PROFICIENCY

This is a rating scale of amount of English that a child uses in school. Kindly refer to this scale for answering the questions below.

0	Never speaks English, never hears it.
1	Never speaks English, hears it very little.
2	Speaks English a little, hears it sometimes.
3	Speaks English sometimes, hears it most of the time.
4	Speaks English all of the time, hears it all of the time.
DK	Don't know

Instruction: Please circle the appropriate answer.

	Questions	Rating					
1	Speaks with you in class	0	1	2	3	4	DK
2	Speaks with other teachers	0	1	2	3	4	DK
3	Speaks with classmates	0	1	2	3	4	DK
4	Overall usage of English at school	0	1	2	3	4	DK

This is a rating scale of English proficiency (how well the child speaks English) in school. Kindly refer to this scale for answering the questions below.

0	Non-proficiency, cannot speak English, has a few words or phrases, cannot produce sentences, only understands a few words
1	Very limited proficiency, cannot speak English, has a few words or phrases, understands the general idea of what is being said
2	Limited proficiency with grammatical errors, limited vocabulary, understands the general idea of what is being said.
3	Good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said.
4	Nativelike proficiency with few grammatical errors, good vocabulary, understands most of what is said.
DK	Don't know

Instruction: Please circle the appropriate answer.

	Questions	Rating					
1	Speaks with you in class	0	1	2	3	4	DK
2	Speaks with other teachers	0	1	2	3	4	DK
3	Speaks with classmates	0	1	2	3	4	DK
4	Overall impression of English proficiency	0	1	2	3	4	DK

On the continuum, select the percentage/hours of time that the child is exposed to each language at school weekly. *Please (x) those that apply with appropriate hours and percentage of exposure per week.*

Languages	Amount of exposure (hours & %)					
	0% 0 hour	20% 10 hours	40% 20 hours	60% 30 hours	80% 40 hours	100% 50 hours
English						
Mandarin						
Malay						
Tamil						
Dialects : (Please specify) I) _______ II) _______						
Other (Please specify: ___________)						

Signed by,

____

( )
Name of Informant

THANK YOU FOR YOUR COOPERATION

Appendix E

Information Letter to Parents

RE: PARTICIPATION IN RESEARCH PROJECT OF PHD STUDY

Your child is invited to participate as a subject in the research project entitled **"The Phonological Development of Malaysian English Speaking Children**: **A Normative study".**

The aim of this project is to establish norms and investigate the phonological/ speech development of typically developing Malaysian English Speaking Chinese children aged between 3 to 7 years old. This project needs a large number of children's participation in order to get a reliable result. We need children from Chinese descent who use English as dominant language.

There will be a two-stage process involved in this study. The first stage will be the selection of subjects via teachers' and parental questionnaires. The second stage will be the actual speech assessment after parental consent.

<u>Stage One:</u>

An *Information Letter* about the study has been sent to principals and teachers to elucidate the purpose of the study. The principal and teachers will be involved in the initial selection of our possible subjects. They will help us to identify the potential subjects for this study in their kindergarten, child-care centre, nursery or school who are likely to meet our inclusion criteria. However, your child's participation is not compulsory, nor is it required by the kindergarten, child-care centre, nursery or school if she/he is identified.

However, if you agree to let your child participate in this study, *parental questionnaire* will be distributed to you via the kindergarten, child-care centre, nursery or school. Meanwhile, *Teacher's Questionnaires* will be disseminated to teachers to obtain their impressions of your child's social history, language usage and proficiency. If your child meets our inclusion criteria, he/she will be invited to participate.

<u>Stage Two:</u>

Prior to your child's participation in our speech assessment, you will be asked to sign the parental consent letter. Similarly, teachers will be requested to sign the teacher consent letter. The assessment will be carried out in the school setting most of the time, but it may be undertaken at home if subjects are not accessible in the school setting for any reasons.

Your child's involvement in this project will be basically naming some single word items on picture cards in English. The production of your child will be recorded in audio, in order to facilitate researcher transcription. The duration of your child's participation in the session will range from 15 to 30 minutes.

The purpose of audio recording is to check the stability of your child's speech production. All the audio recordings will be saved digitally onto CDs, and will be kept in a lockable filing cabinet in the researcher's office. You are assured that these data are not accessible to anyone except the researcher and supervisors (Associate Prof Dr. Margaret Maclagan and Prof. Dr. Michael Robb).

As a follow-up to this investigation, your child might be asked to repeat the same task to check the stability of the child's performance. In the performance of the task and application of the procedures, there would be no risk foreseen. Your right to withdraw your child from the project at any time, including withdrawal of any information you have provided, is preserved.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation. To ensure confidentiality, I) your child's identity will not be made public without your prior consent; II) all the information provided will be confidential and it cannot be known by unauthorised persons; III) all the information, including raw data (audio recordings) and documents, will be properly stored in a lockable filing cabinet in the researcher's office for safekeeping purposes. The raw data except for the audio tape recordings will be destroyed after 10 years.

If your child participates in the study, the audio recording, I) will be held in the University of Canterbury linguistics archives; II) may be made available to bona fide researchers; III) may be quoted in published work or broadcast or used in public performance in full or in part; IV) may be used for teaching purposes; V) may be used as illustrations on a web page (short, anonymous, non-personal excerpts only); VI) may be used as data for the development of a standardized test for phonology of Malaysian English.

This project is being carried out as a requirement of PhD in Speech Language Therapy by Phoon Hooi San (Telephone no: 012-585 2207 (Malaysia), 0064 3 364 2987 ext 7337 (New Zealand) or email: hsp20@student.canterbury.ac.nz) under the supervision of Associate Professor Dr. Margaret Maclagan, who can be contacted at telephone no: 006433642987 ext 7083 (New Zealand) or email:margaret.maclagan@canterbury.ac.nz. We will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Thank you.

Prepared by,	Supervised by,
PHOON HOOI SAN	DR. MARGARET MACLAGAN
PhD Student	Associate Professor & Supervisor
Communication Disorders Department	Communication Disorders Department
University Of Canterbury	University Of Canterbury
New Zealand	New Zealand

Appendix F

Parental Questionnaire

Instruction: Please circle or fill in the appropriate answer.

CHILD'S PERSONAL PROFILE

Name	: _______________	Gender	: M / F
Address	: _______________	Date of Birth	: _________________
	_______________	Chronological Age	: _________________
		School Name	: _________________

PARENTS' PERSONAL PROFILE

Father's name	: _______________	Mother's name	: _________________
Age	: _______________	Age	: _________________
Occupation	: _______________	Occupation	: _________________
Educational Level	: Nil / Primary / Secondary / Tertiary	Educational level	: Nil / Primary / Secondary / Tertiary
Contact number	: _______________	Contact number	: _________________
Number of Children	: _______________	(Position of the child in the family: _________)	

Instruction: Please circle the appropriate answer.

MEDICAL HISTORY

1. Do you have any problems/ complications during your pregnancy? Yes No
   If yes, please specify: _______________________________________
2. Was your child a premature baby? Yes No
   If yes, please specify: _______________________________________
3. Does your child have any medical conditions such as asthma, heart diseases and etc? Yes No
   If yes, please specify: _______________________________________
4. Do you suspect that your child has hearing problem? Yes No
   If yes, please specify: _______________________________________
5. Do you suspect that your child has vision problem? Yes No
   If yes, please specify: _______________________________________

SPEECH AND LANGUAGE DEVELOPMENTAL HISTORY

1. Do you suspect your child has any delays in communication, speech and language? Yes No
   If yes, please specify: ____
2. Is there any family history of communication, speech and language delay? Yes No
   If yes, please specify: ____
3. When did your child produce his/ her first word?
   < 1 year-old / 1 - 1 ½ year-old /1 ½ - 2 year-old / > 2 year-old
4. Does your child follow your verbal instructions? Yes No
5. Does your child communicate in sentences? Yes No
   If yes, how many words in a sentence?
   1- 2 words / 3 - 4 words / > 5 words
6. Since when was your child exposed to English?
   Since birth / 1 year-old / 2 year-old / 3 year-old / 4 year-old / 5 year-old /6 year-old / 7 year-old

7. How many hours or pecent per week is your child exposed to English language input at home? *Please (x) at the appropriate box.*

0 hour (0%)	10 hours (20%)	20 hours (40%)	30 hours (60%)	40 hours (80%)	50 hours (100%)

8. Please refer to the scales below for your child's rating of amount of English use at home. *Please (x) at the appropriate box.*

0	Never speaks English, never hears it.	
1	Never speaks English, hears it very little.	
2	Speaks English a little, hears it sometimes.	
3	Speaks English sometimes, hears it most of the time.	
4	Speaks English all of the time, hears it all of the time.	
DK	Don't know	

9. Please refer to the scales below for your child's rating of English proficiency at home. *Please (x) at the appropriate box.*

0	Non-proficiency, cannot speak English, has only a few words or phrases, cannot produce sentences, only understands a few words	
1	Very limited proficiency, cannot speak English, has a few words or phrases, understands the general idea of what is being said	
2	Limited proficiency with grammatical errors, limited vocabulary, understands the general idea of what is being said.	
3	Good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said.	
4	Nativelike proficiency with few grammatical errors, good vocabulary, understands most of what is said.	
DK	Don't know	

10. What are the languages your child exposed to at home? *Please (x) those that apply with appropriate hours and percentage of exposure per week.*

Languages	Amount of exposure (hours & %)					
	0% 0 hour	20% 10 hours	40% 20 hours	60% 30 hours	80% 40 hours	100% 50 hours
English						
Mandarin						
Malay						
Tamil						
Dialects : (Please specify: I) ___________________ II) ___________________						
Other (Please specify: _______)						

Signed by,

____

( )
Name of Informant

THANK YOU FOR YOUR COOPERATION

Appendix G

Parental Consent Form

Phoon Hooi San
Department of Communication Disorders
University of Canterbury
Private Bag 4800
Christchurch, 8140, NEW ZEALAND

PARENTAL CONSENT FORM

THE PHONOLOGICAL DEVELOPMENT OF MALAYSIAN ENGLISH SPEAKING CHILDREN: A NORMATIVE STUDY

I have read and understood the description of the above-named project. On this basis, I agree to let my child (Name: _________________________, Date of Birth: _________________) participate as a subject in the project, and I understand that my child's participation is not compulsory or required by the kindergarten, child-care centre, nursery or school. In addition, I agree to provide the child's information as required in the *parental questionnaire.* Besides that, I understand that the assessment may be undertaken at home if my child is not accessible in the school setting for any reasons.

I consent to publication of the results of the project with the understanding that confidentiality will be preserved. Therefore I understood that, I) my child's identity will not be made public without my prior consent; II) all the information provided , including raw data and documents (parental and teacher's questionnaire) will be confidential and it cannot be known by any unauthorised person; III) all the information including raw data (audio recordings) will be saved digitally into CDs) and documents (parental and teacher's questionnaire), will be properly stored in a lockable filling cabinet in researcher's office for safekeeping purposes. The raw data except for the audio tapes will be destroyed after 10 years.

I agree that the audio tape recordings from my child's participation:

I) will be held in the University of Canterbury linguistics archives;
II) may be made available to bona fide researchers;
III) may be quoted in published work or broadcast or used in public performance in full or in part;
IV) may be used for teaching purposes;
V) may be used as illustrations on a web page (short, anonymous, non-personal excerpts only);
VI) may be used as data for the development of a standardized test for phonology of Malaysian English.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

NAME (BLOCK LETTER) : ____________________________________
Signature : ____________________________________
Date : ____________________________________

Appendix H

Number of Consonants Sampled in the Stimuli

Sound Classes	Consonants	Syllable-Word Position	Tokens
Stops	p	SIWI	10
		SIWW	7
		SFWF	3
		SFWW	1
		Total	**21**
	b	SIWI	16
		SIWW	3
		SFWF	2
		SFWW	0
		Total	**21**
	t	SIWI	9
		SIWW	15
		SFWF	10
		SFWW	0
		Total	**34**
	d	SIWI	6
		SIWW	6
		SFWF	6
		SFWW	0
		Total	**18**
	k	SIWI	11
		SIWW	9
		SFWF	10
		SFWW	1
		Total	**31**
	g	SIWI	4
		SIWW	3
		SFWF	5
		SFWW	0
		Total	**12**
Nasals	m	SIWI	11
		SIWW	6
		SFWF	4
		SFWW	4
		Total	**25**
	n	SIWI	4
		SIWW	4
		SFWF	18
		SFWW	2
		Total	**28**
	ŋ	SIWI	0
		SIWW	2

		SFWF	8
		SFWW	2
		Total	**12**
Fricatives	f	SIWI	7
		SIWW	4
		SFWF	3
		SFWW	0
		Total	**14**
	v	SIWI	3
		SIWW	3
		SFWF	2
		SFWW	0
		Total	**8**
	θ	SIWI	3
		SIWW	1
		SFWF	2
		SFWW	1
		Total	**7**
	ð	SIWI	2
		SIWW	3
		SFWF	0
		SFWW	0
		Total	**5**
	s	SIWI	9
		SIWW	6
		SFWF	9
		SFWW	3
		Total	**27**
	z	SIWI	3
		SIWW	4
		SFWF	5
		SFWW	0
		Total	**12**
	ʃ	SIWI	4
		SIWW	3
		SFWF	2
		SFWW	0
		Total	**9**
	ʒ	SIWI	0
		SIWW	2
		SFWF	0
		SFWW	0
		Total	**2**
	h	SIWI	9
		SIWW	2
		SFWF	0
		SFWW	0

		Total	**11**
Affricates	tʃ	SIWI	4
		SIWW	2
		SFWF	3
		SFWW	0
		Total	**9**
	dʒ	SIWI	5
		SIWW	4
		SFWF	2
		SFWW	0
		Total	**11**
Glides	w	SIWI	5
		SIWW	2
		SFWF	0
		SFWW	0
		Total	**7**
	j	SIWI	2
		SIWW	1
		SFWF	0
		SFWW	0
		Total	**3**
Liquids	l	SIWI	8
		SIWW	12
		SFWF	11
		SFWW	2
		Total	**33**
	r	SIWI	6
		SIWW	7
		SFWF	0
		SFWW	0
		Total	**13**
Overall Total			**373**

Appendix I

Number of Consonant Clusters Sampled in the Stimuli

Cluster Categories	Clusters	Syllable-Word Position	Token
C + /w/	tw	SIWI	1
		SIWW	0
		Total	**1**
	kw	SIWI	1
		SIWW	0
		Total	**1**
C + /j/	pj	SIWI	0
		SIWW	1
		Total	**1**
	bj	SIWI	0
		SIWW	1
		Total	**1**
	kj	SIWI	1
		SIWW	1
		Total	**2**
	mj	SIWI	1
		SIWW	0
		Total	**1**
	nj	SIWI	1
		SIWW	0
		Total	**1**
C + /l/	pl	SIWI	2
		SIWW	1
		Total	**3**
	bl	SIWI	1
		SIWW	0
		Total	**1**
	kl	SIWI	1
		SIWW	0
		Total	**1**
	gl	SIWI	2
		SIWW	0
		Total	**2**
	fl	SIWI	1
		SIWW	1
		Total	**2**
	sl	SIWI	1
		SIWW	0
		Total	**1**
C + /r/	pr	SIWI	2
		SIWW	0
		Total	**2**
	br	SIWI	3

		SIWW **Total**	1 **4**
	tr	SIWI SIWW **Total**	2 0 **2**
	dr	SIWI SIWW **Total**	2 0 **2**
	kr	SIWI SIWW **Total**	2 0 **2**
	gr	SIWI SIWW **Total**	1 0 **1**
	θr	SIWI SIWW **Total**	1 0 **1**
	fr	SIWI SIWW **Total**	1 1 **2**
/s/ + C	sp	SIWI SIWW **Total**	2 0 **2**
	st	SIWI SIWW **Total**	1 0 **1**
	sk	SIWI SIWW **Total**	1 0 **1**
	sm	SIWI SIWW **Total**	1 0 **1**
	sn	SIWI SIWW **Total**	1 0 **1**
	sw	SIWI SIWW **Total**	1 0 **1**
/s/ + CC	spr	SIWI SIWW **Total**	1 0 **1**
	str	SIWI SIWW **Total**	2 0 **2**
	skw	SIWI SIWW **Total**	1 0 **1**
	skr	SIWI SIWW **Total**	1 0 **1**
	spl	SIWI	1

		SIWW **Total**	0 **1**
/l/ + C	lt	SFWF **Total**	1 **1**
	lk	SFWF **Total**	1 **1**
	lf	SFWF **Total**	1 **1**
nasal + C	mp	SFWF **Total**	1 **1**
	nt	SFWF **Total**	3 **3**
	nd	SFWF **Total**	2 **2**
	ŋk	SIWI **Total**	2 **2**
	ns	SFWF **Total**	1 **1**
	ntʃ	SFWF **Total**	1 **1**
	ndʒ	SFWF **Total**	1 **1**
C + stop	ft	SFWF **Total**	1 **1**
	st	SFWF **Total**	1 **1**
	sk	SFWF **Total**	1 **1**
C + /s/	ks	SFWF **Total**	1 **1**
Overall Total			**65**

Appendix J

Number of Vowels Sampled in the Stimuli

Vowels	**Tokens**
u	16
ʊ	2
ɔ	8
ɒ	19
i	16
ɪ	47
e	5
ɛ	17
æ	23
a	14
ʌ	17
ɜ	4
ə	64
aɪ	13
oɪ	3
aʊ	5
eɪ	11
ɪə	1
ɛə	5
əʊ	17
io	1
aɪə	1
Total	**309**

Appendix K

A Summary of Consonants Sampled in their Various Syllabic Contexts

	INITIAL						MEDIAL		FINAL						
Phonemes	**CV**	**CVC**	**CCV-**	**1 syll**	**XS**	**CCXS**	**XS**	**CCXS**	**VC**	**CVC**	**-VCC**	**1 syll**	**XS**	**XSCC**	**Total**
p	pear	pig	plate prawn spoon spray splash played	paint pink	pillow police car potato papaya pyjamas pencil	present spider	octopus papaya caterpillar hippopotamus grasshopper hippopotamus	aeroplane computer helicopter hospital	up	sheep zip	lamp	jumped			33
b	boy	bus bed ball bird book beach	blue bread bridge	belt box	balloon butterfly bicycle banana birthday behind basket	brother	strawberry	ambulance umbrella zebra cucumber		web		crab		vegetable	28
t	toy	tongue teeth	tree star string		tiger tissue teacher telephone tomato television	twinkle strawberry treasure	guitar butterfly potato tomato motorcycle watermelon caterpillar hippopotamus refrigerator computer potato	vegetable helicopter octopus	eat	hat cat goat foot	paint belt lift cats kicked vest laughed	skirt plate jumped	carrot rocket basket	elephant present hospital	50

d	deer	duck dog	drum	dogs	dolphin dinosaur	dragon	ladder radio crocodile spider	birthday shoulder		red bed bird	hand	bread slide played	lizard	behind	23
k	cow	cat cage	crab quack clock skirt screw square	cats kicked	carrot kitchen camera caterpillar computer	cucumber crocodile	rocket helicopter cucumber chicken crocodile	basket police car octopus thank you		duck fork sock book chick	mask milk pink oink box chicks kicked	clock smoke quack	magic music	bicycle motorcycle twinkle	47
g	go	girl goat	green glove gloves		guitar	grasshopper	tiger dragon	finger	egg	dog leg pig	dogs	frog			17
m	moo	moon mouse mouth	smoke	mask milk	money magic mother motorcycle	music	hammer camera pyjamas tomato hippopotamus watermelon	cucumber umbrella computer washing machine ambulance	am	jam thumb	lamp	drum jumped			29
n	knee	nose knife	new snail		nothing		money dinosaur banana banana	pencil sandwich	on	moon sun	paint hand lunch orange	oven green spoon prawn	balloon seven kitchen telephone washing machine dolphin dragon chicken television aeroplane watermelon	ambulance present elephant behind	38

ŋ							hanger singing	finger thank you washing machine twinkle		ring tongue	pink oink	swing string	nothing singing		14
f	four	fork five fish foot	frog		father finger	flower	sofa elephant telephone	butterfly refrigerator dolphin		knife thief	lift shelf laughed		giraffe		21
v		vase		vest	vegetable		oven seven television			five	gloves	glove			9
θ		thumb thief	three		thank you		nothing	birthday		mouth teeth					8
ð	there	this					father mother brother								5
s	sea	sock sun	skirt slide smoke snail spoon star swing screw square spray splash string		sofa scissors seven seesaw singing sandwich	strawberry spider	seesaw bicycle dinosaur motorcycle	grasshopper basket hospital police car	ice	bus house mouse juice this	box mask cats chicks vest		hippopotamus octopus	ambulance whistle pencil	47
z	zoo	zip			zebra		scissors lizard music present		eyes	nose vase	gloves dogs		scissors pyjamas		14

ʃ	shoe	sheep		shelf	shoulder		tissue washing machine washing machine			fish		splash			9
ʒ							treasure television								2
h	hair	house hat		hand	hammer hanger hospital helicopter hippopotamus		behind	grasshopper							11
tʃ	chair	chick		chicks	chicken		teacher kitchen			beach watch	lunch				9
dʒ	jar	jam juice		jumped	giraffe		magic pyjamas refrigerator	vegetable		cage	orange	bridge	sandwich		13
w		watch web	swing square twinkle quack		whistle washing machine watermelon		flower	sandwich							11
j			new		yellow yo-yo	cucumber music	yo-yo	computer ambulance thank you							9
l	low	leg	plate blue clock glove gloves slide splash played	lamp lift lunch laughed	ladder lizard	flower	balloon pillow yellow elephant telephone ambulance police car umbrella television helicopter	dolphin shoulder butterfly aeroplane		girl ball	belt milk shelf	snail	pencil bicycle twinkle vegetable motorcycle hospital whistle crocodile		47

							watermelon caterpillar								
r	row	red ring	prawn bread bridge tree drum crab green frog screw spray string three		radio rocket refrigerator	present brother dragon strawberry crocodile grasshopper treasure	carrot giraffe orange aeroplane camera strawberry refrigerator	zebra refrigerator umbrella							35
Total	18	42	65	19	62	25	92	51	7	42	40	24	24	33	529

Notes:
This is an adaptation of work proposed by Stoel-Gammon and Dunn (1985), cited in James (2001).

Appendix L

Words with Different Stress Patterns in the Test

Stress Pattern	No of Occurrence	Words		
S	115	All monosyllabic words		
Sw	44	All disyllabic words except those stated in wS		
wS	4	balloon behind	guitar	giraffe
Ssw	4	grasshopper hospital	cucumber	ambulance
Sws	6	butterfly crocodile	dinosaur telephone	octopus aeroplane
Sww	4	camera strawberry	bicycle	elephant
wSs	3	police car	potato	tomato
wSw	5	papaya banana	pyjamas computer	umbrella
Swsw	5	television helicopter	caterpillar watermelon	motorcycle
Swww	1	vegetable		
Swws	1	washing machine		
Swwsw	1	refrigerator		
Swsww	1	hippopotamus		

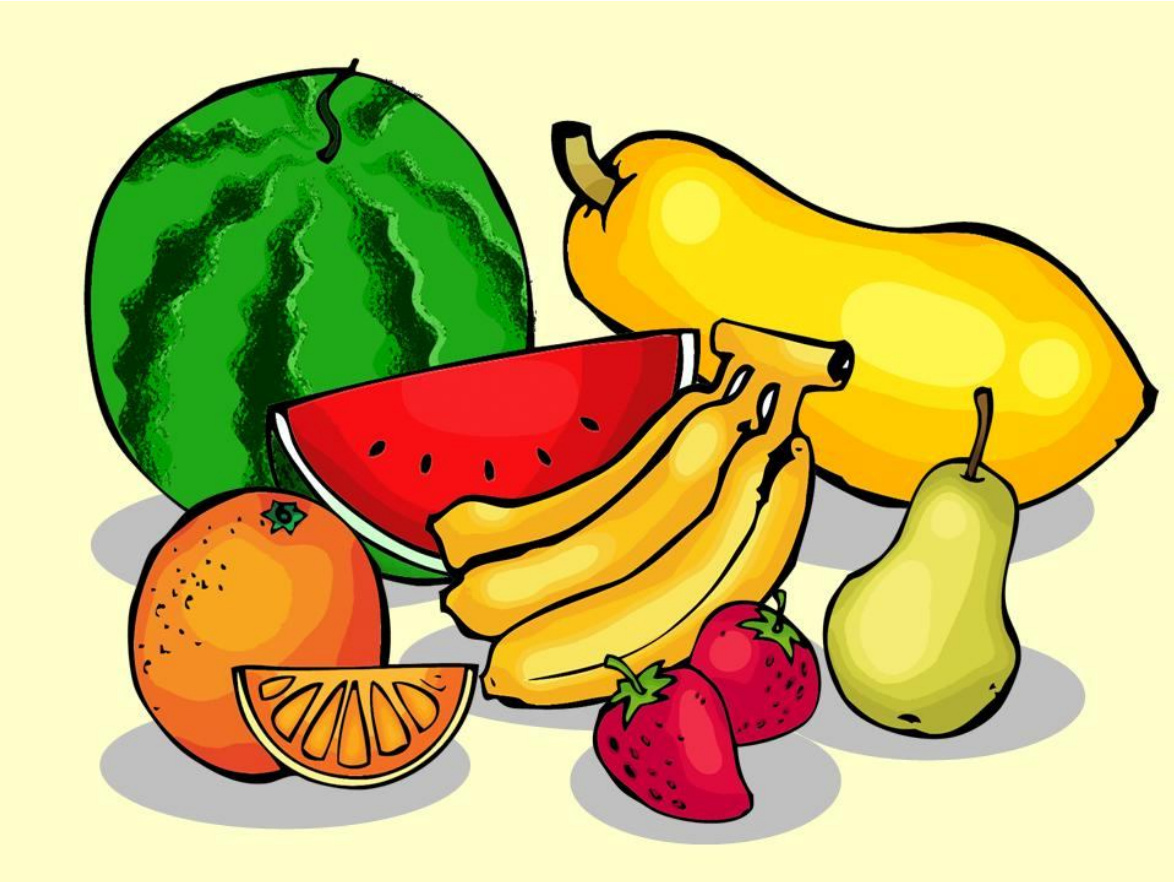
Appendix M

Word List for Assessing Speech Production of Malaysian English speaking Chinese Children

aeroplane
am
ambulance
ball
balloon
banana
basket
beach
bed
behind
belt
bicycle
bird
birthday
blue
book
box
boy
bread
bridge
brother
bus
butterfly
cage
camera
carrot
cat
cats
caterpillar
chair
chick
chicks
chicken
clock
computer
cow
crab
crocodile
cucumber
deer
dinosaur
dog
dogs
dolphin
dragon
drum
duck
eat
egg
elephant
eyes
father
finger
fish
five
flower
foot
fork
four
frog
giraffe
girl
glove
gloves
go
goat
grasshoppe
r
green
guitar
hair
hammer
hand
hanger
hat
helicopter
hippopotamus
hospital
house
ice
jam
jar
juice
jumped
kicked
kitchen
knee
knife
ladder
lamp
laughed
leg
lift
lizard
low
lunch
magic
mask
milk
money
moo
moon
mother
motorcycle
mouse
mouth
music
new
nose
nothing
octopus
oink
on
orange
oven
paint
papaya
pear
pencil
pig
pillow
pink
plate
played
police car
potato
prawn
present
pyjamas
quack
radio
red
refrigerator
ring
rocket
row
sandwich
scissors
screw
sea
seesaw
seven
sheep
shelf
shoe
shoulder
singing
skirt
slide
smoke
snail
sock
sofa
spider
splash
spoon
spray
square
star
strawberry
string
sun
swing
teacher
teeth
telephone
television
thank you
there
thief
this
three
thumb
tiger
tissue
tomato
tongue
toy
treasure
tree
twinkle
umbrella
up
vase
vegetable
vest
washing
machine
watch
watermelon
web
whistle
yellow
yo-yo
zebra
zip
zoo

Appendix N

A Sample Stimulus Picture



This picture was used to elicit the following words:

- Watermelon
- Orange
- Banana
- Papaya
- Strawberry
- Pear

Appendix O

Articulation and Phonology Assessment Record Form

Child Name	: ________________	Gender	: **M**ale / **F**emale
Date of Birth	: ________________	Chronological Age	: ____________________
School	: ________________	Teacher's Name	: ____________________
Assessor's Name	: ________________	Date assessed	: ____________________

SR – Spontaneous
SC - Semantic Cue
BC - Binary Choice
DI - Delayed Imitation
II - Immediate Imitation
NR - No Response

1	SR	SC	BC	DI	II	NR	**2**	SR	SC	BC	DI	II	NR	**3**	SR	SC	BC	DI	II	NR
	got^h							ʃip^h							k^{h}a͡ʊ					
4	SR	SC	BC	DI	II	NR	**5**	SR	SC	BC	DI	II	NR	**6**	SR	SC	BC	DI	II	NR
	mu							p^{h}ɪg							ɔ͡ɪŋk^h					
7	SR	SC	BC	DI	II	NR	**8**	SR	SC	BC	DI	II	NR	**9**	SR	SC	BC	DI	II	NR
	tʃɪ kən							tʃɪk^h							tʃɪks					
10	SR	SC	BC	DI	II	NR	**11**	SR	SC	BC	DI	II	NR	**12**	SR	SC	BC	DI	II	NR
	ha͡ʊs							dʌk^h							k^{h}wæk^h					
13	SR	SC	BC	DI	II	NR	**14**	SR	SC	BC	DI	II	NR	**15**	SR	SC	BC	DI	II	NR
	frɒg							bʌ tə fla͡ɪ							gras hɒ pə					
16	SR	SC	BC	DI	II	NR	**17**	SR	SC	BC	DI	II	NR	**18**	SR	SC	BC	DI	II	NR
	k^{h}æ tə pɪ lə							sneɪl							æ lɪ fənt^h					
19	SR	SC	BC	DI	II	NR	**20**	SR	SC	BC	DI	II	NR	**21**	SR	SC	BC	DI	II	NR
	zɪ brə							dʒɪ raf							dɪə					
22	SR	SC	BC	DI	II	NR	**23**	SR	SC	BC	DI	II	NR	**24**	SR	SC	BC	DI	II	NR
	hɪ pə p^{h}ɒ tə məs							k^{h}rɒ kə daɪl							t^{h}aɪ gə					
25	SR	SC	BC	DI	II	NR	**26**	SR	SC	BC	DI	II	NR	**27**	SR	SC	BC	DI	II	NR
	k^{h}eɪdʒ							zu							rɒ kət^h					
28	SR	SC	BC	DI	II	NR	**29**	SR	SC	BC	DI	II	NR	**30**	SR	SC	BC	DI	II	NR
	ɛ ro pleɪn							hæ lɪ kɒp tə							brɪdʒ					
31	SR	SC	BC	DI	II	NR	**32**	SR	SC	BC	DI	II	NR	**33**	SR	SC	BC	DI	II	NR
	si							ðɛə							bʌs					

34	SR	SC	BC	DI	II	NR	35	SR	SC	BC	DI	II	NR	36	SR	SC	BC	DI	II	NR
	ba͡ɪ sɪ kl							mo tə sa͡ɪ kl							smokʰ					
37	SR	SC	BC	DI	II	NR	38	SR	SC	BC	DI	II	NR	39	SR	SC	BC	DI	II	NR
	æm bju ləns							hɒs pɪ tl							slaɪd					
40	SR	SC	BC	DI	II	NR	41	SR	SC	BC	DI	II	NR	42	SR	SC	BC	DI	II	NR
	swɪŋ							si sɔ							sʌn					
43	SR	SC	BC	DI	II	NR	44	SR	SC	BC	DI	II	NR	45	SR	SC	BC	DI	II	NR
	ʌm brɛ lə							gɜl							splæʃ					
46	SR	SC	BC	DI	II	NR	47	SR	SC	BC	DI	II	NR	48	SR	SC	BC	DI	II	NR
	tʰri							bɜd							bɔl					
49	SR	SC	BC	DI	II	NR	50	SR	SC	BC	DI	II	NR	51	SR	SC	BC	DI	II	NR
	kʰætʰ							kʰæts							dɒg					
52	SR	SC	BC	DI	II	NR	53	SR	SC	BC	DI	II	NR	54	SR	SC	BC	DI	II	NR
	dɒgz							kʰɪktʰ							kʰræb					
55	SR	SC	BC	DI	II	NR	56	SR	SC	BC	DI	II	NR	57	SR	SC	BC	DI	II	NR
	pʰrɔn							ɒk tə pəs							dɒl fɪn					
58	SR	SC	BC	DI	II	NR	59	SR	SC	BC	DI	II	NR	60	SR	SC	BC	DI	II	NR
	dʒʌmptʰ							ro							ʃol də					
61	SR	SC	BC	DI	II	NR	62	SR	SC	BC	DI	II	NR	63	SR	SC	BC	DI	II	NR
	leg							ni							fʊtʰ					
64	SR	SC	BC	DI	II	NR	65	SR	SC	BC	DI	II	NR	66	SR	SC	BC	DI	II	NR
	bitʃ							fɪʃ							tʰrɛ ʒə					
67	SR	SC	BC	DI	II	NR	68	SR	SC	BC	DI	II	NR	69	SR	SC	BC	DI	II	NR
	wɒtʃ							rɪŋ							mun					
70	SR	SC	BC	DI	II	NR	71	SR	SC	BC	DI	II	NR	72	SR	SC	BC	DI	II	NR
	sta							tʰwɪŋ kl							pə dʒa məz					
73	SR	SC	BC	DI	II	NR	74	SR	SC	BC	DI	II	NR	75	SR	SC	BC	DI	II	NR
	bɛltʰ							hæ ŋə							bed					
76	SR	SC	BC	DI	II	NR	77	SR	SC	BC	DI	II	NR	78	SR	SC	BC	DI	II	NR
	pʰɪ lo							kʰlɒkʰ							læmpʰ					
79	SR	SC	BC	DI	II	NR	80	SR	SC	BC	DI	II	NR	81	SR	SC	BC	DI	II	NR
	so fə							vaz							tʰɛ lɪ vɪ ʒən					
82	SR	SC	BC	DI	II	NR	83	SR	SC	BC	DI	II	NR	84	SR	SC	BC	DI	II	NR
	tʰɛ lɪ fon							da͡ɪ nə sɔ							drʌm					

No.	SR	SC	BC	DI	II	NR	Transcription
85							tʰɔ͡ɪ
86							laftʰ
87							pʰleɪd
88							kʰɪ tʃən
89							wɒ ʃɪŋ mə ʃin
90							ʌ vən
91							rɛ frɪ dʒə reɪ t ə
92							spa͡ɪ də
93							wɛb
94							læ də
95							spreɪ
96							maʊs
97							hæ mə
98							skru
99							bɔ͡ɪ
100							lɪftʰ
101							bə lun
102							strɪŋ
103							jo jo
104							wɔ tə mɛ lən
105							ɒ rɪndʒ
106							bə na nə
107							strɔ bɛ ri
108							pʰɛə
109							pə pa͡ɪ ə
110							vɛ dʒɪ tə bl
111							tə ma to
112							kʰæ rətʰ
113							kʰju kʌm bə
114							pə tʰeɪ to
115							dʒæm
116							bred
117							dʒa
118							mɪlkʰ
119							spun
120							fɔkʰ
121							na͡ɪf
122							pʰleɪtʰ
123							eg
124							sæn wɪtʃ
125							a͡ɪs
126							dʒus
127							itʰ
128							lʌntʃ
129							bʊkʰ
130							ʃɛlf
131							tʰi tʃə
132							gɪ tʰa
133							sɪŋ ɪŋ
134							reɪ di o
135							mju zɪkʰ

136	SR	SC	BC	DI	II	NR	**137**	SR	SC	BC	DI	II	NR	**138**	SR	SC	BC	DI	II	NR
	mæ dʒɪkʰ							flaʊ wə							hætʰ					
139	SR	SC	BC	DI	II	NR	**140**	SR	SC	BC	DI	II	NR	**141**	SR	SC	BC	DI	II	NR
	bɒks							skwɛə							æm					
142	SR	SC	BC	DI	II	NR	**143**	SR	SC	BC	DI	II	NR	**144**	SR	SC	BC	DI	II	NR
	nʌ θɪŋ							θif							maskʰ					
145	SR	SC	BC	DI	II	NR	**146**	SR	SC	BC	DI	II	NR	**147**	SR	SC	BC	DI	II	NR
	mʌ ni							pə lis kʰa							wɪ sl					
148	SR	SC	BC	DI	II	NR	**149**	SR	SC	BC	DI	II	NR	**150**	SR	SC	BC	DI	II	NR
	bɜθ deɪ							pʰrɛ zəntʰ							θæŋ kju					
151	SR	SC	BC	DI	II	NR	**152**	SR	SC	BC	DI	II	NR	**153**	SR	SC	BC	DI	II	NR
	brʌ ðə							mʌ ðə							fa ðə					
154	SR	SC	BC	DI	II	NR	**155**	SR	SC	BC	DI	II	NR	**156**	SR	SC	BC	DI	II	NR
	kʰæ mə rə							kɒm pʰju tə							dræ gən					
157	SR	SC	BC	DI	II	NR	**158**	SR	SC	BC	DI	II	NR	**159**	SR	SC	BC	DI	II	NR
	tʰɪ ʃu							pʰɛn sl							ðɪs					
160	SR	SC	BC	DI	II	NR	**161**	SR	SC	BC	DI	II	NR	**162**	SR	SC	BC	DI	II	NR
	sɪ zəz							skɜtʰ							gləv					
163	SR	SC	BC	DI	II	NR	**164**	SR	SC	BC	DI	II	NR	**165**	SR	SC	BC	DI	II	NR
	gləvz							sɒkʰ							zɪpʰ					
166	SR	SC	BC	DI	II	NR	**167**	SR	SC	BC	DI	II	NR	**168**	SR	SC	BC	DI	II	NR
	vɛstʰ							bas kətʰ							ʃu					
169	SR	SC	BC	DI	II	NR	**170**	SR	SC	BC	DI	II	NR	**171**	SR	SC	BC	DI	II	NR
	pʰeɪntʰ							red							jɛ lo					
172	SR	SC	BC	DI	II	NR	**173**	SR	SC	BC	DI	II	NR	**174**	SR	SC	BC	DI	II	NR
	blu							grin							pʰɪŋkʰ					
175	SR	SC	BC	DI	II	NR	**176**	SR	SC	BC	DI	II	NR	**177**	SR	SC	BC	DI	II	NR
	hɛə							a͡ɪz							noz					
178	SR	SC	BC	DI	II	NR	**179**	SR	SC	BC	DI	II	NR	**180**	SR	SC	BC	DI	II	NR
	maʊθ							tʰiθ							tʰʌŋ					
181	SR	SC	BC	DI	II	NR	**182**	SR	SC	BC	DI	II	NR	**183**	SR	SC	BC	DI	II	NR
	hænd							fɪŋ gə							θʌm					
184	SR	SC	BC	DI	II	NR	**185**	SR	SC	BC	DI	II	NR	**186**	SR	SC	BC	DI	II	NR
	θri							fɔ							fa͡ɪv					

<table>
<tr><td rowspan="2">187</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td><td rowspan="2">188</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td><td rowspan="2">189</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td></tr>
<tr><td colspan="6">sɛ vən</td><td colspan="6">tʃɛə</td><td colspan="6">lɪ zəd</td></tr>
<tr><td rowspan="2">190</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td><td rowspan="2">191</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td><td rowspan="2">192</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td></tr>
<tr><td colspan="6">ɒn</td><td colspan="6">bɪ haɪnd</td><td colspan="6">ʌp^{h}</td></tr>
<tr><td rowspan="2">193</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td><td rowspan="2">194</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td><td rowspan="2">195</td><td>SR</td><td>SC</td><td>BC</td><td>DI</td><td>II</td><td>NR</td></tr>
<tr><td colspan="6">go</td><td colspan="6">nju</td><td colspan="6">lo</td></tr>
</table>

Remarks:

Appendix P

Auditory Decision

In the transcription and analyses, dialectal variations of MalE were derived from Chapter 3 in this thesis. All consonant and vowel realizations of adult speakers of MalE were considered as acceptable dialectal variation in the children's study. The instances of acceptable dialectal variations are displayed here.

Notes:

a) All the examples shown focus on the particular consonant/vowel realizations being discussed, without taking into consideration all MalE realizations of the surrounding phonemes.
b) From 32 - 36, schwa in multisyllabic words is produced as a full vowel based on the orthography of the words.
c) When the examples involve vowels in long and short pairs, only one vowel is used in the example.
d) 37 - 40 are individual words that are given a General American English (GAE) pronunciation, rather than a pronunciation rule.
e) 41 - 47 are individual words that are idiosyncratic, without specific pronunciation rules, but are deemed as the acceptable responses.

Description		Features	Examples	
			Words	**Rules**
Affricates				
1	Devoicing of final consonant /dʒ/	/dʒ/ → [tʃ]	cage	/keɪdʒ/→[keɪtʃ]
Fricatives				
2	Devoicing of final /v/	/v/ → [f]	five	/faɪv/→[faɪf]
3	Devoicing of final /z/	/z/ → [s]	eyes	/aɪz/→[aɪs]
4	Stopping of syllable-initial /ð/	/ð/→ [d]	this father	/ðɪs/→[dɪs] /faðə/→ [fadə]
5	Stopping of syllable-initial consonant and consonant cluster /θ/	/θ/ → [t]	thief nothing three	/θif/ →[tif] /nʌθɪŋ/→ [nʌtɪŋ] /θri/→ [tɹi]
6	Fronting of syllable-final /θ/	/θ/→ [f]	teeth birthday	/tiθ/→[tif] /bɜθdeɪ/→ [bɜfdeɪ]
7	Substitution of syllable-initial /v/	/v/ → [w]	vase oven	/vaz/ → [waz] /ʌvən/ →[ʌwən]
8	Devoicing of syllable-initial /ʒ/	/ʒ/→ [ʃ]	television	/tɛlɪvɪʒən/ →[tɛlɪvɪʃən]
Stops				
9	Deaspiration of initial /p/, /t/ and /k/	/p^{h}/, /t^{h}/ and /k^{h}/→ [p], [t], and [k]	pig tongue cat	/p^{h}ɪg/→[pɪg] /t^{h}ʌŋ/→[tʌŋ] /k^{h}æt/→[kæt]
10	Glottalization of final consonant /b/, /d/, /g/, /p/, /t/ and /k/	/b/, /d/, /g/, /p/, /t/ and /k/ → [ʔ]	crab bed dog sheep hat	/kræb/→[kɹæʔ] /bed/→[beʔ] /dɒg/→[dɒʔ] /ʃip/→ [ʃiʔ]

			book	/hæt/→ [hæʔ] /bʊk/→[bʊʔ]
11	Flapping of medial consonant /t/	/t/ → [ɾ]	butterfly	/bʌtəflaɪ/ →[bʌɾəflaɪ]
12	Simplification of final consonant cluster /nd/, /nt/ and /ŋk/	/nd/, /nt/→[nʔ] /ŋk/→ [ŋʔ]	hand paint pink	/hænd/→[hænʔ] /peɪnt/→ [peɪnʔ] /pɪŋk/→[pɪŋʔ]
13	Cluster reduction of final cluster with nasal + stop (/nd/, /nt/, /ŋk/ and /mp/); fricative + stop (/st/, /sk/ and /ft/)	/nd/, /nt/, /ŋk/ and /mp/ → [nasal + ø] /st/, /sk/ and /ft/→ [fricative + ø]	hand paint pink lamp vest mask lift	/hænd/→[hæn] /peɪnt/→ [peɪn] /pɪŋk/→[pɪŋ] /læmp/→ [læm] /vɛst/→ [vɛs] /mask/→ [mas] /lɪft/→ [lɪf]
14	Affrication of initial consonant clusters /tr/, /dr/ and /str/	/tr/→ [tʃɹ] /dr/→ [dʒɹ] /str/→ [ʃtɹ]	tree drum string strawberry	/tri/→[tʃɹi] /drʌm/→[dʒɹʌm] /striŋ/→[ʃtɹiŋ] /strɔbɛri/→[ʃtɹɔbɛri]
15	Reduction of stop and stop consonant clusters (when they are past tense marker)	Stop → [ʔ] or [ø]	played laughed kicked jumped	/pleɪd/→[pleɪʔ] or [pleɪ] /laft/ →[laf] /kɪkt/→[kɪʔ] or [kɪk] /dʒʌmpt/→ [dʒʌm] or [dʒʌmp]
	Liquids			
16	Vocalization or omission of syllable-final consonant /l/	/l/ → [ʊ] or [ø]	pencil snail shoulder	/pɛnsl/→ [pɛnsʊ] or [pɛnsə] /sneɪl/→ [sneɪʊ] or [sneɪ] /ʃoldə/→ [ʃoʊdə] or [ʃodə]
17	Vocalization of cluster /l/	/l/→ [ʊ]	shelf milk	/ʃɛlf/→ [ʃɛʊf] /mɪlk/→ [mɪʊk]
18	Syllable final /r/, alone or in consonant clusters, is silent or realized.	-	four fork girl	/fɔ/→[fɔɹ] or [fɔ] /fɔk/ → [fɔɹk] or [fɔk] /gɜl/ → [gɜɹl] or [gɜl]
19	The use of /ɾ/ for /r/	/ɾ/ → [r]	rocket red spray	/rɒkət/→ [ɾɒkət] /red/→ [ɾed] /spreɪ/→[spreɪ]
Diphthongs				
20	Monopthongization of /əʊ/	/əʊ/ → [o] or [oʊ]	yellow	/jɛləʊ/→[jɛlo] or [jɛloʊ]
21	Monopthongization of /ɛə/	/ɛə/ → [ɛ]	square	/skwɛə/→[skwɛ]
22	Monopthongization of /eɪ/	/eɪ/ → [e]	spray	/spreɪ/→[spɹe]
23	Intrusive glide	/ɪə/→ [jə]	deer crocodile	/dɪə/→ [dɪjə] /krɒkədaɪl/→ [kɹɒkədajə]
Monopthongs				
24	Shortening of vowel	/i/ → [ɪ]	beach	/bitʃ/→[bɪtʃ]

	/i/			
25	Shortening of vowel /u/	/u/→ [ʊ]	spoon	/spun/→ [spʊn]
26	Shortening of vowel /ɜ/	/ɜ/→ [ə]	bird	/bɜd/→[bəd]
27	Shortening of vowel /ɔ/	/ɔ/→ [ɒ]	seesaw	/sisɔ/→[sisɒ]
28	Shortening of vowel /a/	/a/→ [ʌ]	father	/faðə/→ [fʌðə]
29	Lengthening of /ʊ/	/ʊ/→ [u]	foot	/fʊt/→ [fut]
30	Lengthening of /ɒ/	/ɒ/→ [ɔ]	dog	/dɒg/→ [dɔg]
31	Lengthening of /ʌ/	/ʌ/→ [a]	bus	/bʌs/→[bas]
Schwa in Multisyllabic Words				
32	Substitution of /ə/ with [æ] in words with the letter ‘e’	/ə/ → [æ]	bask**e**t rock**e**t	/baskət/→ [baskæt] /rɒkət/→ [ɹɒkæt]
33	Substitution of /ə/ with [a] or [ʌ] in words with the letter ‘a’	/ə/ → [a] or [ʌ]	zebr**a** sof**a** b**a**nan**a** pyjam**a**s papay**a** umbrell**a**	/zebrə/→ [zebra] /sofə/→ [sofa] /bənanə/→ [banana] /pədʒaməz/→ [pədʒamaz] /pəpaɪə/→ [papaɪa] /ʌmbrɛlə/→ [ʌmbrɛla]
34	Substitution of /ə/ with [u] or [ʊ] on words with the letter ‘u’	/ə/→ [u] or [ʊ]	octop**u**s amb**u**lance	/ɒktəpəs/→ [ɒktəpus] /æmbjələns/→ [æmbjuləns]
35	Substitution of /ə/ with [o] or [ɒ] in words with the letter ‘o’	/ə/→ [o] or [ɒ]	aer**o**plane mot**o**rcycle oct**o**pus p**o**liceman p**o**tato t**o**mato croc**o**dile c**o**mputer	/ɛrəpleɪn/→ [ɛɹopleɪn] /motəsaɪkl/→ [motosaɪkl] /ɒktəpəs/→ [ɒktopəs] /pəlismən/→ [polismən] /pəteɪto/→ [poteɪto] /təmato/→ [tomato] /krɒkədaɪl/→ [kɹɒkodaɪl] /kəmpjutə/→ [kɒmpjutə]
36	Substitution of /ə/ with [e] in words with the letter ‘a’	/ə/→ [e]	hippopot**a**mus veget**a**ble	/hɪpəp^{h}ɒtəməs/→ [hɪpəp^{h}ɒteməs] /vɛdʒɪtəbl/→ [vɛdʒɪtebl]
Vowels with GAE Pronunciation				
37	The use of [æ] in words with the letter ‘a’ (START/TRAP alternation)	/a/ → [æ]	gr**a**sshopper ban**a**na b**a**sket m**a**sk	/grashɒpə/→ [græshɒpə] /bənanə/→ [bənænə] /baskət/→ [bæskət] /mask/→ [mæsk]
38	The use of [eɪ] in words with the letter ‘a’ (START/FACE alternation)	/a/→ [eɪ] or [e]	v**a**se	/vas/→ [veɪs] or [ves]
39	The use of /ə/ for /ɪ/ in a few specific words	/ɪ/ →[ə]	tel**e**vision tel**e**phone el**e**phant	/tɛlɪvɪʒən/ →[tɛləvɪʃən] /tɛlɪfon/ →[tɛləvɪʃən] /ælɪfənt/ →[æləfənt]

40 Deletion of unstressed syllables		hel**i**copter vegetable camera strawberry	/hælɪkɒptə/ →[hæləkɒptə] /vedʒɪtəbl/→[vedʒtəbl] /kæmərə/→ [kæmɹə] /strɔbɛri/→ [stɹɔbri]
Idiosyncrasy 41 42 43 44 45 46 47		gl**o**ve p**y**jamas q**ua**ck or**a**nge r**a**dio br**ea**d r**e**d	/gləv/→ [glʌf] /pədʒaməz/→ [pɪdʒaməz] /kwæk/→ [kwak] /ɒrɪndʒ/→ [ɒɹendʒ] /reɪdio/→ [ɹædio] /bred/→ [bɹæd] /red/→ [ɹæd]

Appendix Q

Examples of Dialectal Phonological Processes of both MalE Speaking Adults and Children

No	Dialectal Phonological Processes	Words	RP	Transcription	
				Adult	Child
1	Glottal Replacement	bed	/bɛd/	[be**ʔ**]	[be**ʔ**]
2	Devoicing of Stops	dog	/dɒg/	[dɒ**k**]	[dɒ**k**]
3	Deaspiration of Voiceless Stops	pig	/pʰɪg/	[**p**ɪʔ]	[**p**ɪʔ]
4	Final Consonant Devoicing	cage	/keɪdʒ/	[ke**tʃ**]	[ke**tʃ**]
5	TH-Stopping	there thank you	/ðɛə/ /θæŋkju/	[**d**ɛː] [**t**æŋkju]	[**d**ɛ] [**t**æŋkju]
6	TH-Fronting	teeth	/tiθ/	[tɪ**f**]	[ti**f**]
7	Vocalization	bicycle	/baɪsɪkl/	[baɪsɪk**ʊ**]	[baɪsɪk**ʊ**]
8	Omission of Final /l/	motorcycle	/məʊtəsaɪkl/	[motosaɪk**ə**]	[motosaɪk**ə**]
9	Substitution of /v/ with [w]	vase	/vaz/	[**w**as]	[**w**as]
10	Medial Consonant /ʒ/ Devoicing	treasure	/trɛʒə/	[tɛlɪvɪ**ʃ**ən]	[tɛlɪvɪ**ʃ**ən]
11	Final Stop Cluster Reduction	lamp mask	/læmp/ /mask/	[læ**m**] [ma**s**]	[læ**m**] [ma**s**]
12	Omission of Past Tense Markers	kicked	/kɪkt/	[kɪ**k**]	[kɪ**k**]
13	Simplification of Diphthongs	goat hair	/gəʊt/ /hɛə/	[go**t**] [h**ɛː**]	[go**ʔ**] [h**ɛː**]
14	Vowel Merging	beach bird	/bitʃ/ /bɜd/	[b**ɪ**tʃ] [b**ə**ʔ]	[b**ɪ**tʃ] [b**ə**ʔ]
15	Use of Full Vowel for Unstressed Vowel	hippopotamus octopus tomato	/hɪpəpɒtəməs/ /ɒktəpəs/ /təmatəʊ/	[hɪp**o**pot**e**məs] [ɒkt**o**pəs] [t**o**mɛto]	[hɪp**o**pot**e**məs] [ɒkt**o**pəs] [t**o**mɛto]

Appendix R

The Taxonomy of Phonological Processes

I) Syllable Structure Processes

Syllable structure processes are changes that modify the syllabic structures of the target word. These include:

1 Unstressed Syllable Deletion

Deletion of an unstressed syllable.

Examples:

telephone	/tɛlɪfon/	[tɛfon]
pyjamas	/pədʒaməz/	[dʒaməz]

2 Final Consonant Deletion

Deletion of a final consonant or consonant cluster.

Examples:

dog	/dɒg/	[dɒ]
milk	/mɪlk/	[mɪ]

3 Cluster Reduction

Simplification of a consonant cluster by reducing it to one sound (or two sounds if the target cluster consists of three consonants). The actual form of the reduction differs according to the type of target cluster; the most common reduction patterns are described below:

a. In /stop + liquid/ clusters, the stop is usually maintained and the liquid deleted.

Examples:

bread	/bred/	[bed]
glove	/gləv/	[gəv]

b. In post-vocalic clusters composed of /liquid + stop/ or /liquid + nasal/, the liquid is usually deleted.

Examples:

milk	/mɪlk/	[mɪk]
belt	/bɛlt/	[bɛt]

4 Epenthesis

Insertion of an unstressed vowel, usually [ə]. This process usually occurs in one of two environments.

a. Occur in Initial cluster

Examples:

blue	/blu/	[bᵊlu]
clock	/klɒk/	[kᵊlɒk]

b. After a final voiced stop

Examples:

crab	/kræb/	[kræbᵊ]
bed	/bɛd/	[bɛdᵊ]

II) Substitution Processes

Substitution processes are those sound changes that substitute one class of sounds for another. The substitution processes are grouped according to target phonemes they affect.

6 Liquid Gliding

a. Substitution of glide for a prevocalic liquid; /r/ and /l/ are usually replaced by either [w] or [j].

Examples:

ring	/rɪŋ/	[wɪŋ]
balloon	/bəlun/	[bəjun]

b. Gliding also occurs in consonant clusters

Examples:

bread	/brɛd/	[bwɛd]
glove	/gləv/	[gjəv]

7 Vocalization

Substitution of a vowel, usually [o] or [u], for a syllabic liquid.

Examples:

pencil	/pɛnsəl/	[pɛnsʊ]
snail	/sneɪl/	[sneɪʊ]

8 Stopping

Substitution of a stop for a fricative or an affricate. This process occurs most commonly in word-initial position, although it can occur in other positions as well. As shown in the examples, the general place of articulation of the target phoneme is maintained while the manner of articulation changes.

a. Stopping of fricatives

Substitution of a stop for a fricative.

Examples:

sock	/sɒk/	[tɒk]
fish	/fɪʃ/	[pɪʃ]

b. Stopping of affricates

Substitution of a stop for an affricate.

Examples:

chair	/tʃɛə/	[tɛə]
jam	/dʒæm/	[dæm]

9 Velar Fronting

Substitution of an alveolar for a velar consonant. This process occurs more commonly in initial than in final position.

Examples:

cow	/kaʊ/	[taʊ]

10 Palatal Fronting

Substitution of an alveolar for a palatal consonant.

Examples:

shelf	/ʃɛlf/	[sɛlf]
shoe	/ʃu/	[su]

11 Deaffrication

Substitution of a fricative for an affricate.

Examples:

chair	/tʃɛə/	[ʃɛə]
lunch	/lʌntʃ/	[lʌnʃ]

12 TH-fronting

The shift from an articulation with the tongue to one made with the lips.

Examples:

thumb	/θʌm/	[fʌm]
thief	/θɪf/	[fɪf]

14 Glottal replacement

The use of glottal stop to replace stop.

Examples:

sock	/sɒk/	[sɒʔ]
cat	/kæt/	[kæʔ]

15 Affrication

The use of affricate to replace fricative.

Examples:

zoo	/zu/	[dʒu] or [dzu]
sock	/sɒk/	[tʃɒk] or [tsɒk]

III) Assimilation Processes

Assimilation processes are sound changes in which one sound become more similar to another.

16 Voicing assimilation

a. Prevocalic voicing

The change of a voiceless stop into a voiced one when preceding a vowel within the same syllable.

Examples:

cat	/kæt/	[gæt]
teeth	/tɪθ/	[dɪθ]

b. Postvocalic voicing

The devoicing of a voiced stop at the end of a syllable.

Examples:

crab	/kræb/	[kræp]
bed	/bɛd/	[bɛt]